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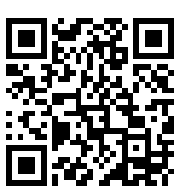

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THE JUNCTION OF THE INDIAN AND RUSSIAN TRIANGULATION WORK IN THE PAMIRS.

THE following account of the preliminary work in connection with the junction of the British and Russian survey work in the Pamirs as well as extracts from letters of the late Lieut. H. G. Bell, R.E., has been reprinted with the kind permission of the Surveyor-General in India from the *Records of the Survey of India* for 1912–13.

In 1913 the work was continued and completed by Lieut. K. Mason, R.E., who gives an interesting account of it in the June number of the *Geographical Journal*.

Kashmīr Secondary Operations.—In 1909, the International Geodetic Conference passed a resolution embodying the desirability of effecting a junction between the Indian triangulation and Russian work in the Pamīrs. Accordingly, during the summer months of 1911, after the completion of observations which carried the Kashmīr Principal Series to points not far south of Gilgit, reconnaissances were undertaken of the country intervening between that series and the Pamīrs, with a view to discovering a practicable route to be followed by the Indo-Russian connection. Three schemes were suggested to the officers entrusted with the reconnaissances.

The first was to extend the Kashmīr Principal Series as far as the Sakiz Jarab Range, on which stations would be established to the east of the Darkot Pass. From these points it was hoped that observations might be made to Concord and Salisbury Peaks on the Afghan-Russian border, which peaks would be included by the Russian observers in their triangulation on the Pamīrs. The investigation of the practicability of this scheme was undertaken by the late Lieut. H. G. Bell, R.E. He reported that the main chain of peaks of the Sakiz Jarab Range was inaccessible and that the hills immediately to the south, only a little less difficult to negotiate, though they offered a satisfactory view to the north, were hidden from the south by high inaccessible peaks, effectually obstructing triangulation carried from the terminal points of the Kashmīr Principal Series.

A second scheme involved the carrying of secondary triangulation from the Principal Series, up the Yasin and Karambar Valleys to the neighbourhood of the Gazan and Bhort Passes, from which the Concord and Salisbury Peaks might be visible. After finding that the carrying of triangulation to the Darkot Pass was not feasible, Lieut. Bell turned his attention to the Karambar Valley. He found that

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secondary triangulation could probably be taken as far as Harmot or Imit but that beyond this place the valley narrows considerably between precipitous hills and further progress was impossible.

The third alternative scheme was examined by Mr. Wainright. This was for secondary triangulation to break off from the Principal Series just south of Gilgit and to follow the Hunza and Kanjut Valleys as far as the Kilik and Mintaka Passes, and from thence to extend over the Taghdumbash Pamīr to a junction with the Russian points. This scheme was found to be practicable. The valley as far as Hunza is comparatively open and the hills, though difficult, not inaccessible. Beyond Hunza, though the valley narrows in somewhat, fairly well-conditioned figures can still be laid out as far as Misgar. Here, in order to obtain triangles of sufficient length of side, the series has to run westward, out of the valley, and bending again in a general northerly direction, approach the Kilik Pass from the south-west. From this pass the triangulation can be easily carried across the Taghdumbash Pamīr to the Russian points near the Beyik Pass.

As, by the time the reconnaissances had been carried out, the season was getting late and unfavourable weather was setting in, nothing further could be done that year. The Party returned, in the autumn of 1911, to India and a programme of work for 1912 was elaborated. With its final scheme worked up as far as possible, the detachment left India in May, 1912, to commence the actual observations. Recruited under Lieut. H. G. Bell, R.E., during the latter half of April at Rāwalpindi, after completing its equipment, it marched to Gilgit. Bandipur was reached on the 8th May, some little delay having been caused by deep snow encountered in the Tragbal and Burzil Passes. By May 31st all the detachment had been assembled at Gilgit and there the plan of operations was given final shape. Reconnaissances of the previous year had shown that the Hunza and Kanjut Valleys were probably practicable for triangulation, which, following this course, might be carried up to the Taghdumbash Pamīr to effect a junction with the Russian triangulation, the terminal points of which were situated in the neighbourhood of the Beyik and Sarikoram Passes. It was proposed to base the triangulation on a side of the Kashmīr Principal Series in latitude 35° 55′ and longitude 74° 20′ ; to carry it thence northwards to about latitude 36° 12′, where, following the valley, it would trend eastwards to longitude 74° 20′ and at this point, near Atābād, it would again extend north to the Kilik Pass in latitude 37° 07′. From this pass, the Russian points lie to the north-east on the far side of the Taghdumbash Pamīr in about latitude 37° 20′, longitude 75° 10′.

Between Gilgit and Hunza, the valley of the Kanjut River is comparatively open, the hills on either side are more accessible than is the case higher up the valley and as far as Hunza a graded road runs

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along the right bank of the stream. In the neighbourhood of Baltit lofty snow masses rise above the valley on both banks. On the left bank, Rakiposhi Peak attains a height of 25,550 ft., while towering over the nearer masses on the right are the Hunza Peak (25,050 ft.) and a group of summits all over 24,000 ft. in height.

Beyond Baltit the hills close in to the stream, the slopes become barren and rugged and progress correspondingly more difficult. In many places the pathway is carried along the face of precipitous scarps supported, gallerywise, on iron or timber struts; in others the pathway climbs the hillside till it is possible to skirt the top of precipices too formidable to be dealt with by any such type of bridging. These steep ascents and subsequent descents to the villages lying close to the river, make marching in the summer months most trying; the heat in the narrow rocky valley is intense and travelling is, whenever possible, done before sunrise. After the flood water in streams has subsided, about November, the hillside path over the difficult stretches is generally forsaken for the river bed. Four marches above Baltit, the lower end of the much serrated and crevassed Batur Glacier is encountered. About 1 mile in width at this point, this glacier, striking the Kanjut Valley at right angles, forces its way across the river bed, butting up against the hills on the left bank. Seven marches from Baltit the junction of the streams from the Mintaka and Kilik Passes is reached at Murkushi. Here, there is a small grassy level thickly covered with willows, the last timber seen on the march to the Pamírs. From Murkushi two routes lead to the Taghdumbash Pamír, one *viâ* the Kilik, the other over the Mintaka Pass.

The scheme decided upon by Lieut. Bell was that he and Mr. McInnes should march at once to the Russian points on the Beyik Pass and, commencing building and observing there, work gradually over the Kilik and Mintaka Passes and down the Kanjut Valley to effect a junction with the triangulation which Mr. Collins and Mr. Abdul Karím were to carry from its lower end as far up the Hunza Valley as they could. In the meantime Mr. Abdul Hai was to effect a junction between the Kashmír Principal Series and the figures laid out by Mr. Collins in the Hunza Valley.

The various sections left Gilgit for their respective localities during the first week of June, but owing to unfavourable weather, very little reconnaissance and no observing was possible until 23rd. It was during this spell of bad weather that Mr. Abdul Hai's Camp on Yasho Chish Peak was struck by lightning. His servant was killed; his recorder was severely burnt, while he himself received a shock necessitating his return to Gilgit and eventually to headquarters in India.

Yasho Chish is one of the stations of the Kashmír Principal Series and was the first point visited by Mr. Abdul Hai in his attempt to

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effect a connection between this series and Mr. Collins' Hunza Valley work. On the recall of Mr. Abdul Hai, the responsibility of this connection fell to Mr. Collins who had, in the meantime, carried the reconnaissance and building of stations up the right bank of the river as far as Hunza. Leaving Mr. Abdul Karīm to continue from there the building up both sides of the valley, he returned to Gilgit and took up the observations, commencing at the base stations on the Kashmīr Series. By July 28th he had completed work at four stations when he received news of Lieut. Bell's death and returned again to Gilgit to assume charge of the detachment.

Lieut. Bell and Mr. McInnes, on leaving Gilgit early in June, marched through the Kanjut Valley and over the Mintaka Pass to the Russian stations on the Beyik, which they reached on June 20th. Lieut. Bell then took up the work of observing while Mr. McInnes proceeded southwards towards the Kilik Pass, reconnoitring and selecting stations. While on the Beyik, Lieut. Bell spent one day with the officers of the Russian Survey Party encamped near Kizil Rabāt. Compliments were exchanged and experiences related. In one of his letters Lieut. Bell alludes briefly to this meeting; "dressed in long boots of the country and a *choga*, escorted by three local headmen and by Hunza interpreters, I crossed the Beyik Pass into the Russian territory to meet the Russian Survey Officers. I was met by a cavalcade consisting of the Colonel, a Captain, a Lieutenant and their escort of cossacks and cavalry."

Lieut. Bell had completed observations at three stations and had moved camp to his fourth station near the Mintaka Pass when he was seized, on 19th July, by an attack of appendicitis. Obtaining no relief and suffering much, he moved down to Lup Gaz, some 8 miles north of the Mintaka Pass, and on 25th morning sent to Mr. McInnes, then in the neighbourhood of the Kilik Pass, asking for assistance. Mr. McInnes arrived at Lup Gaz on the afternoon of the 25th to find Lieut. Bell very weak. During the previous five days there had been no sign of any definite improvement in his condition and after Mr. McInnes' arrival at Lup Gaz, the malady seemed to become gradually more acute. Late in the evening Lieut. Bell began to sink rapidly and about midnight he died. His body was interred temporarily near the Mintaka Pass to be brought down later, when the state of the Kanjut River permitted, to Gilgit for burial in the cemetery there.

The detachment was now reduced to three observers. The lateness in the season, the remoteness of the locale of operations and the impossibility, in any case, of completing the triangulation this year, were against the sending of another officer to take Lieut. Bell's place.

The charge of the detachment now devolved on Mr. Collins, who continued observations on the section between Atābād and Gilgit,

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directing Mr. McInnes to take up the selecting and building of stations in the difficult country between the former place and Misgar, while Mr. Abdul Karīm undertook the laying out of triangles southwards from the Kilik Pass, where Mr. McInnes had stopped, to Misgar. Mr. McInnes laid out six stations, forming sufficiently good figures, carrying the series to Misgar where he connected with Mr. Abdul Karīm's section. This last portion of the triangulation between the Kilik Pass and Misgar, however, was very poor. The course selected for the series was badly chosen and the figures laid out were unsatisfactory. Before, however, a better disposition of stations could be arrived at, the weather got rapidly worse, and winter began to set in; new snow had fallen down to a level of about 11,000 ft., and the work of observing became daily more difficult. Field operations were accordingly closed on 18th September, the detachment recalled to India and disbanded on October 25th at Dehra Dūn.

The following are extracts from the letters written by Lieut. Bell and give a more detailed account of the work done by his party:—

EXTRACTS FROM LETTERS FROM THE LATE LIEUT. H. G. BELL, R.E.

"*Bandipur, May 17th*, 1912.—To-morrow morning early, I start off on my northward way. Everything is as ready as it can be; all my loads are made up and coolies engaged. We are going in two parties, each taking about 120 coolies. The first pass is open for ponies; of the second I have no certain news."

"*May 21st.*—Since leaving Bandipur, I have been through all sorts of trials and tribulations. I got away from Bandipur in fine weather, and rode up the zig-zag ascent to Tragbal Bungalow, height about 9,000 ft. There was still some snow round the bungalow and in the evening it rained. Early in the morning I got everything packed up and we started off to cross the Tragbal Pass, 11,700 ft. It is quite an easy pass, but it is a bad place to get caught in a storm. It started to snow just as we got over the pass, and in the valley below it was pouring with rain. I found the bungalow in a sorry state, only two rooms were habitable; the others and most of the outhouses have been carried away by an avalanche. Luckily it cleared up soon after we arrived and we were all able to dry ourselves. Next day was fairly fine and I went down to Gurai Valley and then along the Kishenganga Valley to Gurais. There I had to change my ponies for coolies, so the loads had to be rearranged."

From Gurais to Burzil, the march was apparently slow and troublesome. The coolies had not yet settled down to routine and the distribution and adjustment of loads was not effected without some trouble.

"We reached Burzil about 3 p.m., the last few miles being over the snow. The bungalow itself was quite surrounded by it. Once more

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I had to rearrange the loads and get everything ready for an early start on the morrow. We all got off before 3 a.m. and started the ascent of the pass by lantern light. Over the snow, I toiled along after the coolies and got up to the top of the pass by 8 a.m. just as it began to snow. The descent to Chillum is long but gradual and we got there by 4 p.m. in pouring rain and snow. At Chillum I had again to change my coolies for ponies, so I paid off the coolies and once more made up pony loads. Next morning it was snowing very hard, so I decided not to march that day and sent the ponies down the valley to get food and shelter. Next morning it was beautifully fine but the ponies which I had ordered did not turn up. A few came in the morning, the rest did not come till 4 p.m. So I left my assistant there and came on with what ponies there were. It soon began to snow again and then it got dark. The road was strewn with boulders that had lately come down the khud, and some were still falling. However, I went on in practical darkness, running across the bad places to avoid falling rocks; one only missed me by a few yards. Several of the ponies died of exposure, chiefly owing to the carelessness of their owners who left them in the snow without any covering or food.

"Eventually I reached Godhai Bungalow at 9.30 p.m. The majority of the ponies arrived a short time after.

"I left Godhai at 11 a.m. and got here, (Astor), another 17 miles march by 5.30 p.m. The scenery along this last march is very grand. In one place, the road passes through a deep and narrow rocky gorge and from above it one gets a peep at my old friend Nanga Parbat. To-day I halted to let my assistants catch me up. They got in in the afternoon. The road in front is badly broken, so there is not much chance of getting on just yet. I don't know what has become of the other half of my detachment, which should be two days behind me. I can't find out as the telegraph line has been broken for three days. The weather has been awful for this time of the year and has quite upset my plans. I hope to leave here to-morrow or the day after, so I ought to be in Gilgit before the end of the month."

Bell reached Gilgit on May 28th. Owing to the recent rain, the heat in the Indus Valley was not as great as usual and apparently no troubles were met with beyond those incidental to long marches and bad roads.

Between May 28th and June 4th, Bell was occupied in organizing his detachment for its work in the Kanjut Valley. This was no easy matter and seems to have caused a good deal of worry. On June 4th he wrote: "It has been a great difficulty arranging supplies for my whole party and now my men are all dissatisfied and giving me a lot of trouble because in a place like this, where food is scarce, it is impossible to buy a large quantity at the usual bazaar rate. It is getting quite hot here. I shall be glad to get away to a cooler

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climate." In this same letter he mentions that on the day after his arrival in Gilgit he had been in bed with severe stomachic pains which he put down to bad water which, he thought, he must have drunk somewhere.

On June 4th, making an early start, Bell with one of his assistants marched 18 miles to Nomal in the Hunza Valley. He seems to have been greatly rejoiced by the greenness of this village, well irrigated and cultivated in the midst of a barren forbidding country. On the succeeding days, he marched to Chalt, Hindi, and Baltit, which he reached on the 7th. Of his arrival at Baltit he wrote: "Marched from Hindi to Baltit, the residence of the Mīr of Hunza: quite a pleasant ride through a succession of villages. A few miles out we were met by the Mīr's younger son. On our arrival, we found a tent pitched for us in the Mīr's garden and presently he, his Wazīr and his eldest son came to welcome us."

On 8th he stayed at Baltit, dismissing his pony transport and rearranging the loads for coolies.

On 9th June, "though we were up very early, it was 7 a.m. before we got all our loads packed on to the coolies and started off, a task made all the more difficult as we had to do everything through interpreters. The Mīr came to see us off and we started on foot as the made road stops here, and there is only a track winding up and down the precipices, no road for a nervous traveller, as it consists in many places of very kutcha-built galleries hanging over the precipices and a false step means a fall of several hundred feet. This evening we camped in a flat place by the river, the village of Atābād being in the hills above.

"10th. We continued our march to Gulmit, the road being rather worse than yesterday and the heat on the hillside rather trying. We camped in an orchard of apricot trees and were much worried by flies.

"11th. This morning our departure was delayed somewhat by our having to change some of the coolies. However we only had a short and easy march to Pasu, a village near a big glacier.

"12th. We left Pasu early, and had to cross the Batur Glacier which took us about an hour climbing up and down the masses of dirty black ice, bestrewn with all sorts of débris. We breakfasted on the glacier and continued our march to Khaiber, another small village where we met the hero of a hundred fights, a very cheery old man aged about a hundred.

"13th. To-day, we did another easy march, crossing the river by quite a decent bridge and camped at the village of Sost. We had a bad storm in the afternoon and the dust got blown into everything. The Mīr's brother came to see me in the afternoon and I had a fairly long talk with him.

"14th. It was raining slightly very early this morning but soon

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cleared up and we started off. Soon we had to ford the river, rather a perilous proceeding. We had two ponies on which several of us got across but the coolies had to wade. However they all got over safely though they were nearly washed away. The track was very bad along this march; in places it went along steep cliffs with very little foothold. In the afternoon we reached Misgar, the last village in British territory.

"15th. This morning we sent the main camp on to Murkushi and started to climb a hill above Misgar with just enough kit for the two of us for one night. We got up above the snow line by about 3 p.m., and camped there. In the evening we both had bad headaches and did not eat much dinner.

"16th. It was snowing when we got up but we climbed still higher and reached one peak only to find another still higher in front of us. The coolies had got behind. I had to go back to fetch them. Thus we went on a little further and came to such steep cliffs that we could not get up there with all the fresh snow about, so we gave it up and came back to camp; packed up and came down to Misgar. There we got ponies and rode on here (Murkushi), arriving about 5 p.m.; a very strenuous day. We were on the move for 12 hours with barely a rest."

On 17th. They halted at Murkushi to reassemble their kit and to ration the coolies. On the following day, they marched to Gul Khwāja at the foot of the Mintaka Pass in a snowstorm which, however, stopped in time to allow of tents being pitched and camp established "in the dry." In the afternoon Bell went out in the hope of securing an ibex head, but without success. On 19th, the party crossed the Mintaka Pass. "Again the track was very bad, and gave no end of trouble. One yak went over backwards and was only saved from an untimely end by several of us holding on to his horns till his load was cut loose. We crossed the Mintaka Pass in a snowstorm about 12 noon, leaving British India behind and entering Chinese Turkistan and the "Roof of the World." The descent on this side brought us down into a wide open valley covered with green grass where lots of yaks were grazing. We followed the valley down a long way till we reached an encampment where we were ushered into a "yart," a round dome-shaped wooden framework covered with felt, draped with embroidery inside and carpeted with thick rugs where tea and sweets were brought to us. The Sarakoulis are fine big men, very cheery and good-looking. Clothed in their many wadded coats, long boots and fur caps they look very picturesque. They certainly are most hospitable. They keep one "yart" always ready for guests. Some of our kit did not arrive till after dark owing to the difficulties of the road and the bad weather.

"20th. We stayed in camp to-day as it was very cold and stormy; repacked our kit and prepared to separate on the morrow. Several

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headmen came to see me and I had to give them tea and entertain them."

On 21st Bell moved towards Beyik while his assistant, Mr. McInnes, turned off towards the Karchanai Pass. The next day Beyik Pass was reached and the two Russian triangulation stations located, the camp being established in a small open valley at the foot of the pass. On 23rd, he had a stiff climb to the eastern survey point in a snowstorm. By the time he had reached the summit, however, the weather had cleared and he got a view all round. He remarked that the Pamīrs on the far side were much lower than those he had crossed and the mountains quite insignificant.

On 24th, he moved camp down the nullah back to Beyik, going out in the afternoon to select his first station. He also wrote a letter, in French, to the Russian Survey Officer, whom he thought to be encamped at Kizil Rabāt. He learnt later that, though expected, this officer had not yet arrived.

On 25th, he moved his camp into a small nullah close under his first station.

He writes on 27th: "We had more snow last night, but it cleared up in the morning and I moved up the nullah north of my camp and climbed up a long way and pitched my small tent in a very damp and cold spot, the only more or less flat one available.

"28th. Up at sunrise; moved further up the nullah and got on the ridge; went along its knife-like edge to a more or less flat place where I put up a signal station. A fine sunny day but even then my feet nearly got frozen with the cold. I stayed up there some time and then came down to my main camp; a long descent from 17,000 to 12,000 ft. On my arrival, I found McInnes there. After consultation, we decided to give up the scheme of the Karchanai Pass and try to go round by the Kilik."

On 29th, camp was moved again up the Beyik Nullah towards the western Russian point. The weather had improved, for Bell remarks that it seemed "to have changed for the better at last." On July 3rd, he was again at his first station about to commence observing. On this day he was not in camp till 9.30 p.m., for after completing the march, he went out after ovis poli. He secured one head but the stalk had taken him a long way from camp. "By the time we had cut his head off, it was dark and we had a long trek back to camp and an icy cold stream to cross. However I got there by 9.30 p.m. hungry and weary but elated and was up by 6 next morning."

On July 4th, Bell commenced observing under difficulties; a high wind was blowing and snow began to fall, and it was not till the next day that he managed to get work at this station finished, moving down afterwards to his main camp.

On July 6th, we "climbed up the Russian west station and found

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the Russian signal deep in snow. However with 12 men and a bucket and phowrah we cleared away 10 ft. of snow all round it and pitched the observatory tent and made a platform for our tents. In the evening it started to blow and snow.

July 7th, I did observations and spent the rest of my time cooking my food, for when I go up to the stations, I can't take my cook as I have only 12 coolies to take up my own and my babu's kit, etc.

On 8th, he finished work and moved back to his main camp, going out in the evening after poli again but failing to get a shot.

The next day Bell went over to the Russian Survey camp, where he was received by the Russian officers, a Colonel, a Captain and a Lieutenant, and entertained in a "yart."

He wrote: "We were very merry and they most hospitable. I had to write my name in their pocket books and they in mine. Then we adjourned to photograph each other and returned for more refreshment. Then they escorted me back to the pass and we parted the best of friends.

"So now I have been into three empires this season and to the most northern point the Survey of India has reached."

On 10th and 11th, he prepared the Russian eastern point to receive his observatory tent, finished observations there and came down to his main camp. On 11th, he wrote: "I am very fit and have quite got my mountain legs and feel full of work."

From this station, Bell marched back towards the Mintaka Pass, to his last camp at Lup Gaz.

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DELHI DURBAR.

SPECIAL REPORT ON AMPHITHEATRE.

THE "Durbar Amphitheatre" is held to include the whole of the location where the Durbar Assemblage took place, and the site which it occupied in this case was identically the same as that chosen for the 1877 and 1903 Durbars.

This report comprises the execution of the following works, but does not deal with any Military or Railway arrangements and operations:—

I. The Durbar Shamiana with raised dais where Their Majesties received the homage of their Indian nobility and subjects.
II. A Throne Pavilion from which His Majesty announced his Coronation as King-Emperor to all present.
III. A covered Durbar stand for the accommodation of the Indian Chiefs, Durbaris, "Pirdah Nashin" ladies, the high officials of the Government, and certain privileged spectators.
IV. An extensive uncovered stand for the general public, school children, etc.
V. Erection of a flagstaff from which to fly the Royal Standard.
VI. Retiring accommodation for ladies and gentlemen.
VII. Water supply arrangements.
VIII. Fire protection.
IX. Laying out the grounds.
X. Roads and paths.
XI. Matting and felt.
XII. Police parking grounds for vehicles.
XIII. Temporary offices, workshops and godowns.
XIV. Dressing and clearing up.

And these works will now be described in detail.

I. *The Durbar Shamiana.*—This was an open Shamiana 60 ft. by 60 ft. with an interior portion 20 ft. by 20 ft. raised and reserved for the dais with thrones on which Their Majesties were seated. The roofing of this portion was raised to a central finial from which the crimson velvet covering fell away towards the four sides. A deep fringe of crimson velvet highly embroidered with gold threadwork

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was suspended on all four sides and the roof covering and fringe being lined with pale buff silk. Within the central portion there was hung over Their Majesties a richly embroidered "Chandoa" of velvet with gold tassels. Gilt finials and hammered copper-gilt posts completed the decoration of the Shamiana, which, in the bright sun with a light breeze playing on it, presented a magnificent appearance of oriental splendour. The plinth of the Shamiana was raised in ornamental plaster panels and was enclosed by a low railing in neat open geometric design with stepped approaches from all sides. Carpets specially designed and made in the Montgomery and Lahore Jails overlaid the red felt floor covering.

The central portion was again raised and was carpeted with crimson velvet handsomely embroidered in gold. The Throne chairs were placed on a small central dais 8 ft. by 8 ft. by 18 in. high, panelled in white marble and covered with an all-gold carpet made specially in Delhi. The flooring which was exposed at the platforms and plinths and on the stepways was laid with white marble, and the plaster panelling, railings and buttresses were painted plain ivory white. In order to prevent any undue vibration of the framework of the Shamiana by wind, the posts were guyed by flexible wire chords anchored into the ground and wound round with gold tape.

From the Durbar Shamiana there was a raised Processional Way to the Throne Pavilion which was 149 ft. long by 20 ft. wide, with a low gilt post and white cord railing down each side, and having a flooring of heavy red felt.

II. *Throne Pavilion.*—Particular attention was given to the construction and ornamentation of this structure as the Royal visit to India may be said to have been centred on this spot. In order to give adequate command for Their Majesties both to see and be seen by the vast concourse of troops and spectators assembled within the Amphitheatre, the pavilion was erected at the summit of a succession of rising terraces working up to a height of 15 ft. at the Throne Dais.

These terraces were 100 ft. radius octagonal, 80 ft., 50 ft., and 20 ft. square, the heights being 2, 5, 3½ and 3 ft. respectively, which, with the Throne Dais 8 ft. square and 1½ ft. high, gave suitable proportions and the required height. The plinths of all the terraces were highly ornamented, the plaster panels being beautiful examples of the Lahore School of Art design and plaster work. The lower octagonal terrace had a railing of small gilt posts with single white cotton rope and was laid with red bajri. On the plinth of the 80-ft.-square terrace a low openwork plaster panelled railing was erected. This and the 50-ft. terrace had white marble flooring.

As in the case of the Durbar Shamiana, the 20-ft.-square terrace and Royal Dais were laid with gold-embroidered crimson velvet and solid gold carpets respectively.

All approach stepways, which were not covered with red felt, were

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of white marble. The Pavilion itself consisted of a made-up steel framework on which was fitted the golden dome with its beautifully ornamented plaster parapets, eaves, frieze, brackets and pillar casings. From under the eaves a velvet-roofed awning measuring 50 ft. by 50 ft. was spread out on all four sides in order to give protection from the sun. This awning had a deep fringe on which embolic signs and the Royal Monograms were embroidered in gold, and inside it was lined with pale yellow silk. Over the thrones again there was a suspended "Chandoa" of singularly rich design and make. The posts supporting the awning were encased with stamped copper-gilt sheathing and the gold guy lines gave the awning rigidity and finish.

The plinth panelling and platforms and all plaster and woodwork up under the awning was painted ivory white and above that the dome and parapets were covered with gold leaf with the result that the whole Throne Pavilion made up a dazzlingly beautiful structure well worthy of the momentous occasion.

III. *Covered Durbar Stand.*—The stand was in the form of a semi-circle having a radius of 100 yards, on the centre of the Throne Pavilion; but subsequently the Pavilion was pushed further out in order to stand more prominently in the Amphitheatre area.

The centre of the mound lay over that of the spectators' stand of the 1903 Durbar, and the stand, as in that case, faced out towards the north.

This stand was roofed over as a semi-circular shed divided off into 24 bays each having a depth of 60 ft. clear with an extra 20 ft. thrown out at the back giving an over-all roof of 80 ft. The ends were rounded off and left open. The ordinary accommodation amounted to 12,256 seated, and about another 2,400 persons standing on the terreplain at the back, but the actual numbers on the stand at the time of the Durbar was probably in excess of these totals as extra chairs were put in.

The front row 4 ft. wide was reserved for Indian Princes and the highest officials, behind them in three rows being the other Durbaris and officers. A passage 5 ft. wide separated those doing homage from the privileged public who were seated in the next 23 rows.

Indian ladies, limited to the family members of the Princes, were accommodated in screened-off boxes which were placed at the back of the centre eight blocks and constructed with partitions and curtains so that absolute privacy was obtained.

A Block at the East end of the stand was specially reserved for Press representatives, and, in addition, a stand was erected in the line of the troops near the Throne Pavilion for cinematograph operators and photographers, and they were also allowed to take up position in the eaves kiosks on the roof of the Durbar stand itself.

The seat tiers were made 6 in. high radiating on the common centre, and by reducing the number of roof supports along the front to a

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minimum, and by placing them in pairs on the sides of the passage-ways, which were aligned on the centre spot, it was possible for everybody to get a good view of the proceedings.

The whole stand was made up of earth-filling, and to prevent the legs of the chairs sinking in thick coarse matting was laid on the seat tiers and covered over, in the case of the terrace and four rows in front and passage-ways with thick red felt, and on the back seats and terreplain with red serge.

By way of decoration, the columns of the inner edge were cased in with ornamented plaster work and the eaves of the roof were worked in with a pierced parapet, plaster barge boarding, eaves panels and fringe and brackets, which, painted white and picked out in gold, made a most effective frontage.

On the roof itself, which was of plain smooth roll-jointed iron sheets painted pale cream colour, there were eaves kiosks in the Indo-Saracenic design over the ends of the passages, and a cresting of plank fretwork with smaller ridge kiosks in the centres of the spaces between the passages. The plaster woodwork of the kiosks and cresting was all painted white. In the case of the two end gables, the same eaves decorative work was carried round under the roof and the gable was filled in with panelled open plaster work. At the back the columns were boxed in, a fretted barge board suspended all round and the terreplain passages railed off; all woodwork being painted white.

The whole shed was given an under-roof ceiling of whitewashed canvas stretched tight on wooden frames, which, with the iron work of the trusses, which was left exposed under the ceiling, were painted white. The covered blocks were marked off by letter boards suspended from the trusses and also fixed to the back row of columns, and by post signboards for the end uncovered blocks.

New unarmed bentwood chairs were provided for the Durbaris and spectators generally, but special easy chairs of very handsome design were given to the Princes and highest Government officials.

The radiating passage-ways in combination with the wide front terrace and the cross passages and open terreplain at the back made access to the seats an easy matter.

IV. *Spectators' Uncovered Stand.*—An open earthwork mound was constructed for spectators generally which was about 2,800 ft. long and 1,000 sq. ft. in cross section. This was also semi-circular in shape on a radius of 300 yards and the same centre as the covered stand. A large amount of levelling and other miscellaneous work, the aggregate of which was considerable, was carried out in connection therewith.

Labour Used.—Work was begun on March 15th by the 34th and 48th Pioneers, while the 32nd and 107th Pioneers were gradually drafted in about the middle of April to help and also do the earthwork

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of the covered stand, and levelling and dressing operations. By May 15th when all military labour left Delhi, the greater portion of this earthwork had been finished off and the remaining work was completed during the hot weather by coolie labour.

General Organization.—A European Subordinate assisted by a Sub-Overseer was in immediate charge of the work and spent the whole day on it. His duty was to receive and account for all plant and materials used, arrange for the maintenance in good order of the railway plant, and give profiles and general technical assistance to the Pioneers.

A R.E. officer was in general charge of all Military labour employed by the Superintendent of Works, whether on the Amphitheatre or elsewhere. His duty was to distribute and explain to the different units the work to be done, arrange for the supply and distribution of necessary plant and materials, and to see, so far as could be done without interfering with the internal work of a unit, that the work was carried out as efficiently as possible.

Earthwork Arrangements.—The chief difficulty was the carriage of the earth and the lack of means to do it with. Along half the length of the uncovered mound, the minimum lead was 400 ft.; along the bulk of the other half the minimum was fully 100 yards, while for the centre portion the lead was no less than 300 yards.

As the work was only decided on about March 6th and the 34th and 48th Pioneers commenced work on March 15th, there was no time to arrange for an efficient means of transport. Work was commenced with baskets and wheelbarrows, and donkeys were gradually brought in. Tram line and wagons were searched for everywhere but the collection of these necessarily took some time, and though nearly 100 of the latter were at work by the middle of May the majority of them had only been in use for a few days.

As it turned out it would have been well worth while to spend as much as Rs.15,000 on purchasing plant at first, but funds were not available and nothing could be done. Not only would the nett loss after re-sale have probably been less than the hire of donkeys, but the work would have progressed very much faster and cost less.

Tip Wagons and Trollies Used.—Nearly all the tip wagons used were either :—(*a*). 18-in. gauge wagons of 10 cubic ft. capacity borrowed from Jaipur. (*b*). 2-ft. gauge Decauville wagons of 27 cubic ft. capacity, some borrowed from Patiala and some bought. (*c*). 2-ft. 6-in. gauge wagons of 50 cubic ft. capacity borrowed from the N.W. Railway.

All three kinds were used under the same considerations by the 107th Pioneers, and they found that the amount of earth moved per wagon per diem was about in the proportion of 12 : 11 : 9 respectively. The greater the height of the banks the greater the advantage of the smaller wagon. In every case one man per 5 cubic ft. capacity

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should be allowed for hauling when there are any gradients to negotiate. In addition to these, 20 Fowler trollies, which consisted merely of a framework on wheels 2-ft. 6-in. gauge, were obtained on loan from Peshawar, and proved most useful when provided with side and bottom boards. Some attempts to fit improvised tipping bodies of wood and corrugated iron with angle-iron frame to these and some smaller trollies proved unsuccessful in the case of the larger and not very successful with the smaller trollies.

Line Used.—This consisted of Decauville tram line partly provided with iron sleepers and of Kalka Simla line of 41½ lbs per yard. It was found that, except where heavy trucks were used on light line, sleepers were only necessary at curves, in other cases loose rails were merely buried 1 or 2 in. in the earth and pegged down here and there. The sleepers used were ordinary kail baulks cut into pieces about 3 ft. 6 in. by 5 in. by 2½ in.

Method of Working.—When working donkeys it was found most necessary to keep the loaded animals approaching the work away from empty ones leaving it. The best plan was to drive them up to the top of the work by one path, along it for about 15 yards, during which they are unloaded, and back by another path.

With tip wagons there are two methods of working, one by a circular line running parallel with the bank and rising with it, and the other by single length of line running straight up at the tipping end.

The former has several theoretical advantages, but it was found in practice that the latter gave the better result owing to its greater flexibility. Every wagon should have a considerable number of baskets, the number ranging according to the size of the wagon. While the wagon is being emptied these baskets are filled by a party of diggers and placed in position alongside the line. When the wagon arrives its haulers empty into it the basketfuls which are standing ready and take them back to the fillers who have cut sufficient loose earth to fill them at once ; in this way filling is rapidly carried out. Meanwhile a party of shovellers will have been engaged in moving into position the earth last brought to the work, so as to make room for the next consignment. In order to ensure that the wagons shall not be delayed by throwing their earth on to the line, a small trench should be made alongside the line after each trip, unless the tipping is done down a bank. It is hardly necessary to say that on a single line all the wagons must work together ; if one is sent off and filled or emptied before the others it will cause confusion and delay. Every wagon has a maximum efficient incline, according to its capacity, above which it is best to throw the earth up by shovels.

The Fowler trollies were filled either with filled baskets or with earth. In the one case the haulers form a line and pass the baskets up by hand, the earth being immediately deposited where required.

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In the other a separate body of shovellers is needed to move the earth from alongside the trolly to the desired spot, and it takes longer to empty the trolly, but more earth is carried per trip by this method. In practice there appeared to be nothing to choose between them, the latter method would, of course, be the best where earth had merely to be thrown down a bank.

Accommodation, etc.—The uncovered stand was raised 3 ft. by a puddled mud wall on the inner edge and finished to an inner slope of one in 4·6 with 27 steps, each 2 ft. wide, and a back slope of 1 to 1½, which was partially grassed, but not with any degree of success owing to failure of rains.

Stepways were made up the back slope at 50-ft. intervals and each half of the mound was divided into 24 blocks. The two halves of the mound were separated by a vista 100 ft. wide. On the seven blocks nearest the vista and on each side of it risers were fixed made of 5-in. by 1-in. planks screwed to 2-in. by 2-in. by 2-ft. 6-in. pegs. The three blocks nearest the vista on each side were covered with cocoa-nut matting for school children to sit on. The next four blocks on each side had rough fixed benches for which pieces of planks 2 ft. 6 in. long were driven 1 ft. into the ground at 3-ft. intervals and other planks were nailed over the top. Small battens 2 in. deep were nailed in front and behind for strength and also for appearance.

On the next 16 blocks "pens" were constructed. These consisted of a rail and post fence for each block. Each of the pen blocks was subdivided into four compartments. The front rail and post fence was continuous and was strutted back. Between each of these blocks was a passage-way 3 ft. wide and between the two front and two back compartments another similar passage-way for the Police. The uprights were 5 in. by 5 in. by 6 in. and were at 8-ft. spacing. The front uprights were 5 in. by 5 in. by 8 ft. and were strutted by the same scantlings. The rails were 24 ft., 16 ft., 15½ ft. and 15 ft., and were used as they could be best fitted in, the joints being wired. On the last or end block of each half were benches, and the circular ends of the mound were grassed.

The inner mud wall was mud plastered and whitewashed and the post and rails of the pens were painted white.

Passage-ways and partition rails radiated on the common centre. The blocks were allotted off without further subdivision and a pleasing colour design was effected by the occupants of each block wearing puggries of a certain colour, thus giving plots of pale yellow, green, orange, pink, etc., as seen from the Throne. The accommodation allotted provided for about 36,000 spectators, but this allowed for a considerable amount of space per person and as the stand was eventually densely packed it is probable that there were not less than 50,000 spectators on it during the ceremony.

V. *Flagstaff.*—By the co-operation and courtesy of the Director

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of the Royal Indian Marine, the Bombay Dockyard supplied on loan two spars measuring 90 ft. and 60 ft. which together made up a flagstaff 135 ft. high from the ground to the crown at the top. This magnificent and graceful flagstaff was erected by the 1st Sappers and Miners under the direction of a Royal Indian Marine officer who remained in charge and at the Durbar ceremony saw to the breaking of the Royal Standard.

The foundations being of a particularly boggy and unreliable nature it was necessary to set up the butt of the Flagstaff on an embedded platform laid over a nest of piles.

Although it overtopped the Amphitheatre by a great height, the Flagstaff did not look in any way out of place, but on the contrary gave the appearance of fitting in very well with its surrounding features, and with the Royal Standard filled by the breeze the general effect was most imposing and attractive.

VI. *Retiring Rooms.*—In addition to retiring-room tents for Europeans and Indian gentlefolk and screened arrangements for natives, there was a building at the back of the Durbar stand, specially constructed for the purpose, in which two rooms were reserved and furnished as a provision against possible fatigue or temporary indisposition of Their Majesties, and the remaining two rooms were set aside for the same purpose for the privileged public. Each of the four suites comprised a comfortably furnished cloak room with large retiring room and a screened-off attendance courtyard at the back.

VII. *Water Supply.*—Not only was drinking water laid on in pipes with stand-post delivery in all parts of the Amphitheatre grounds, but there was also a supply of irrigation water from the Jumna Canal which gave water to the grounds both by natural flow and also by means of a pumped supply where the ground lay at a higher level.

VIII. *Fire Protection.*—The arrangements made consisted of a 6-in. water main under pressure which led direct to the Throne Pavilion and the covered Durbar stand, supplemented by the horsed steam Fire Engine, which was very kindly lent by the Jubbulpore Municipality.

This engine, with the horse and firemen, was located in a station close to the stand and it stood ready for immediate action. "Minimax" Fire Extinguishers were also fitted to the posts of the stand at convenient places for use in putting out any conflagration in its earlier stages.

IX. *Laying out the Grounds.*—Grass lawns were marked out round the Throne Pavilion and grassing was started in the middle of July, "doop" grass being bought from contractors at 12 annas per maund and dibbled in. Rain appeared to be imminent at that time but unfortunately it held off with the result that the grass on the back

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slopes of the spectators mound, except that which was watered and did fairly well, nearly all dried up. Soon after this a few showers fell and the spectators mound was completed and the inside lawns and "puttries" started. For this some 10,000 cubic ft. of village manure were bought at Rs.7 per 100 cubic ft. and some 3,000 cubic ft. of good night-soil manure was also used. The quantity of saltpetre and sand in the soil necessitated this. The local grass did not become green for about seven days and a considerable portion died altogether. Cultivated grass from the Agra Park was then used and did very well indeed, getting quite green in two days time. Considering the extreme poverty of the soil and the difficulties experienced, the grass lawns turned out very fairly well, but repairs were constantly necessary. The back of the Durbar Mound was turfed owing to being left till November on account of workmen, etc., employed on the roof of the Durbar, and this did very well indeed and remained green without any repairs.

Flower beds were made on the berms and with these and the white railings and green grass the back slopes of the covered stand looked very neat and smart from the approach roads.

Palm tubs and flower beds were put alternatively along the sides of the three vistas and processional, arrival, and departure roads which were most effective. The operations covered the laying of about 2½ millions sq. ft. of lawn and 8 millions of grassing.

X. *Roads and Paths.*—As the roads within the Amphitheatre were very extensive and only for use on a single occasion, it was necessary to make them to look well and cost little, so that a single coat of stone metal only was given with a layer of bajri over it which was renewed just before the Durbar and watered to keep the dust down. Bajri paths 24 ft. wide were made dividing up the massed troops. Outside the Amphitheatre, roads with better wearing value had to be given as the traffic in materials, etc., was very heavy and continuous. There, a kunkar coating was added and oil spreading given to keep down the dust. The length of roads constructed amounted to 6,086 ft. of 20 ft.; 2,376 ft. of 16 ft.; 2,700 ft. of 12 ft.; and 1,756 of 10-ft. metalled roads; and these are not included in the general report on roads. The remaining portions of the travelling widths were covered with bajri. Besides an allowance in the Amphitheatre estimate, another for Rs.4,857 was sanctioned in Secretary's No. 6,873, dated 6th September, 1911, which provided for the roads in connection with traffic arrangements.

XI. *Matting and Felt.*—As the treads of the seat tiers in the covered Durbar stand were only of rammed earth it was necessary both to lay coarse matting to prevent the legs of the chairs from sinking in, and also to cover up this matting with a floor cloth for appearance sake. The matting was purchased from that which was left over from the Allahabad Exhibition, and as a thin floor cloth would have

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got rucked up and torn, it was decided to lay red felt on the front terrace and passages and for the first four rows of seats, and behind that a cheap red serge was put down which looked better and was more serviceable than the ordinary rough Indian red floor cloth. The felt and serge were purchased in England by Messrs. Clarke & Co., of Simla, on a commission percentage. These materials were taken up and re-used for the same purpose at the Review Ground Stands. About 5,500 square yards of felt and 10,000 square yards of serge were utilized for the Durbar.

XII. *Parking Grounds.*—For the regulation of traffic the Police authorities had the advantage of converging roads of approach from all sides, and they devised a system of separation by which the vehicles on any road kept to their own delivery platforms and parking grounds. This necessitated the construction of special feeder roads with arrival platforms and the levelling and dressing of the carriage parking grounds. The arrangement made proved eminently successful as both in coming and in going there was no delay or confusion, and any one could call up their motor or carriage within a few minutes of leaving their seat at the Durbar. The expenditure on these feeder roads is dealt with under Item X.—Roads, and the clearing and dressing of the parking grounds comes within the whole expenditure under that heading, Item XIV., for which no special estimate has been sanctioned.

XIII. *Temporary Offices, Workshops and Godowns.*—A temporary shelter, for the artizans employed to work under, for the storage of tools and goods and for the accommodation of the works office of the Assistant Engineer in charge of the Amphitheatre, was erected consisting of three open barracks, two 100 ft. by 20 ft. each, and the third 147½ ft. by 20 ft.; two rooms for office purposes and two for stores. All these were arranged to enclose an open courtyard measuring 106⅔ ft. by 100 ft. An irrigation channel supplying water for works purposes ran right through the premises, and pipe water was laid on for drinking and washing. Just before the Durbar the whole structure was dismantled excepting one of the store rooms which was left standing and converted into a station for the Jubbulpur Fire Engine which, with its horses and firemen, stood ready for immediate action in case of fire breaking out in or near the Amphitheatre.

Being constructed on light open lines the sheds suffered to a certain extent from a violent storm during the monsoon period, and repairs were carried out under a separate estimate.

XIV. *Dressing and Clearing Up.*—It came as a revelation to find what a tremendous amount of work there was in generally doing up the Amphitheatre grounds, and practically speaking a whole battalion of Pioneers were employed for six weeks on this alone. The work for the most part consisted in preparing the carriage parking grounds, dismantling up and clearing up workshops, filling hollows and water

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courses, clearing away débris and tidying up generally. The expenditure incurred on this has been debited separately as no provision was made in the original estimate.

General Remarks.—The decorative work in the Covered Durbar Stand, Durbar Shamiana and Throne Pavilion was designed and carried out by the Principal, Mayo School of Art, Lahore. The students from this Institution came down to Delhi and camped out at the Amphitheatre so as to be always near their work, which was of a very intricate and extensive nature.

A large number of skilled artizans from Lahore and Amritsar were employed on the embroidery work of the Shamiana, Throne awning and carpets. An army of carpenters carried out the woodwork and the casting and erection of the plaster of Paris work. The time available being very short for the large amount of work of this nature, it became necessary to work long hours and at high pressure as the Durbar drew near in order to complete in time, and it is only to the devotion to duty of the staff, subordinates and workmen employed that it was possible to do so.

Night shifts were tried but given up after a time as the men got numbed and careless with the cold, and it was found better to work them long hours instead.

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A NARRATIVE OF THE SEVERAL TRANSACTIONS OF THE FRENCH IN THEIR ATTACK OF FORT ST. GEORGE, AND OF THE GARRISON IN THE DEFENCE OF THAT PLACE. ANNO 1758 AND 1759.

(Concluded).

February 1st. The Enemy last night repaired the damaged Merlons of their Battery, and endevored to lower the Cells of the Embrasures from whence in the morning they fired three Guns but with little effect, and were soon obliged to close their Embrasures as in the preceeding Day. The Haarlem, the Enemys Battery to the Southward and one Gun to the Northward fired on the Shaftsbury at Intervals all Day, and sent several Shot thro' her; we in return fired at the Ship, and the Enemys Southern Guns, but in the Evening a Twenty four pounder burst on St. Thome bastion and wounded 6 Men, of which 4 were mortally hurt. The Governour being there very narrowly escaped with a slight scratch. The Cuddalore Schooner came near the road in the Evening, and then stood away to the Northward again. Our Working Party last night was 54 Pioniers and 35 Sepoys who were employed as follows. 24 Pioniers pushing on our Gallery relieved each other every Six hours; the rest with the Sepoys were repairing the Pallisadoe in the Gorge of the North Lunette, repairing the Embrasures in the East Flank of the Royal Bastion, and levelling the Earth beat down on the banquets of the lower Curtain. The Enemy threw but few Shells last night or in this Day.

2nd. Last night the Enemy worked at repairing the Parapet and lowering the Embrasures of their Battery on the Crest of the Glacis in which they opened again this Morning 5 Embrasures, and fired with Two Guns on the Angle of the Demi-bastion, which rarely struck the Top of the Parapet. Our Working Party was 51 Pioniers, and 100 Sepoys who were employed in repairing the Fascine Battery, in setting up Pallisadoes in the Gorge of the North Ravelin, and in repairing the Parapets of the North East Bastion. 27 Men were employed in pushing the Gallery under the North covered Way, and under the covered way near the blind. The Enemys Battery which fired a Shot now and then from one Gun was silent before noon. About three in the Afternoon Usoff Cawn and the Enemy seem'd to be engaged in some Topes 4 or 5 Miles N. West and continued firing till 5 o'Clock. The Haarlem, and the French Frigate drew off last night and anchored to the Northward so that

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the Shaftsbury had only two Guns from the Southward and one from the Northward to fire on her.

3rd. This morning about day break the Enemy sprung a Mine behind the Counterscarp of the Ditch opposite the East End of the Cuvette, and opened the Wall about 20 or 25 feet, but did no other damage than wounding 3 or 4 Men and an officer in the Demy with bricks. The intent of this opening is not very clear, because if it was designed as a descent into the Ditch it is so injudiciously made that 4 Guns from the Flank of the Royal fire direct into it; but I rather think it was intended to destroy the entrance to our Mine which was about 20 feet from theirs, or else they sprung it thinking we were at work on the out side, for The Engineer and people at work on our Mine heard the Enemy very distinctly at work within the Counterscarp about 2 oClock in the Morning and alarmed them by knocking and calling out to bring the Match that we might spring our Mine. Our working Party of 54 Pioniers and 40 or 50 Sepoys was employed on the Mine, and Countermine and thickening the Parapet of the Demi-Bastion near the Saliant Angle which part the Enemys battery seems to be intended against.

4th. Last night the Enemy endevored to make their Guns on the Glacis bear on the Demi and North East Bastions by lowering the Embrasures, but after firing a few Shot in the Morning they closed them as before. In short the oblique fire from the flank of the Royal Bastion and direct fire from three Guns on the North East is so superior to the Enemys that they cannot possibly stand it, and our Shells above an hour or two every morning. Our Working Party consisted last night of 53 Pioniers and 50 or 60 Sipoys who were employed in thickening the Parapet of the Demi-Bastion and carrying on the two Gallerys. The Enemys Large Shells being all expended is the reason we imagine that they only threw from Time to Time 8 or 10 Inch Shells from two Mortars in the Crochet at the foot of the Glacis (K). The fire of their Artillery from the several Batterys except that at the burying Ground of four Guns was also very slow. The two Large Guns at the Bar were this Morning with drawn, and a field Piece brought thither.

5th. This morning early we were surpriz'd with a sight 6 or 7 Vessells under Sail and concluded them at once to be our Ships from Bombay, but the advance of the Day soon discovered to our View the Enemys two Ships and 5 Small Vessells going out of the road and Standing Eastward, and as soon as the Sea Wind came in they stood to the Southward. This extraordinary Motion we can no ways account for, but by supposing the Enemy have had advice of our Ships being some where on the Coast, and fearful of theirs falling into our hands have sent them to take Shelter under Pondichery. A Red Flag was seen at the great Mount in the morning, and a great smoke, so that we conclude Usoff Cawn is got

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thither, and hope he will soon get near to us. The Enemy last night fired a good deal of Musquetry, and this Morning fired three or four rounds from two Guns on their breaching Battery but were obliged to close it immediately, and scarce fired a Musquet Shot all Day. The four Guns at the New hospital were silent or with drawn, and only two fired slowly at the old hospital. Our working Party of 53 Pioniers, and 40 Sepoys were employed on the Demi bastion, North Ravelin, and Gallerys. Yesterday that under the North covered Way fell in, and had like to have discover'd us to the Enemy, but being no further advanced than the banquet of our covered Way we turned to the right till we got into the Center of the old Town wall, and then advanced forward towards the Enemys Battery. Indeed we imagined the Gallery to have been under the Parapet and were surpriz'd to see by the face of the covered Way that we were not so far.

6th. This morning six Embrasures of the Enemys battery to the Northward appeared to be repaired ; and by their with drawing the Guns from the new hospital it is supposed they intend to restore their first grand Battery. Nothing else appeared to have been done as to their works, and their Battery on the Glacis was silent. Our Working Party consisting of 50 Pioniers, and as many Sepoys was employed in repairing the Parapets of the Demi : Bastion and carrying on our Two Gallerys ; thirty Sailors were Landed from the Shaftsbury to assist the Artillery, and the Ship no longer apprehensive of the Enemy went out into deeper water.

7th. Early this morning the Enemy saluted us with four Guns, and 1 Mortar from their old grand Battery, which cannot be much to the credit of the Attack, thus to retreat after having had four Guns in battery five Days on the Glacis. The old North East bastion which with three Guns has been maintained the whole Siege seems to be the object of their old (but once more new) Battery. The Angle of the Demi bastion is also battered from these four Guns, and as many from the burying Ground fire on the face. So that the Enemy have now as it were gone back to the 6th January and have on us the following batterys. At the old hospital 2 Guns plunging into and enfilading the whole North Front, At the Burying Ground four Guns battering the face of the Demi bastion, At the Grand Battery four Guns firing on the Saliant Angle of the Demi, and on the old North East Bastion, and one Mortar throwing Shells of 10 Inches into the Town. On the Zig Zag which crosses the Ridge of the Glacis three Mortars throwing 8 and 10 Inch Shells into the Demi, and N. East Bastion, the blind and Fascine Battery. Our working Party of 50 Pioniers, and as many Sepoys were employed in raising, and repairing the left face of the North Ravelin, repairing two Embrasures on the North face of the Royal Bastion, and in carrying on the Gallerys.

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8th. The Enemy this Morning fired with five Guns from their grand Battery, but the greatest part of the Shot from thence and the burying Ground go over our Parapets. Nothing new appeared in their approaches. Captain Barker and my self this Morning went off in a Mossula Boat on board the Europe Ship, and rowed from thence a little to the Northward, with an Intent to come back along shore and take a View of the Enemys Works in reverse. We got so far North, and so near, as to see plainly behind their grand battery which at first appeared very ill man'd but in an instant it was filled, and a Gun or two turned against us with which they fired five rounds at the Boat. This obliged us to make an hasty retreat, and prevented us from seeing so much of their works as we proposed. A Deserter who had formerly been in our Service came in from the Enemy this Evening, and informs us that the reason they abandoned their Battery on the Glacis was because they lost many men from the superiority of our fire had several Guns disabled, and were constantly apprehensive of being blown up by our Mine which they heard we were making under it. He also assures us that they are not making any Mines on their part as we apprehended. Our working Party of 50 Pioniers, and 27 Sepoys were employed in repairing the Embrasures on the North face of the Royal, which fire on the Enemys grand Battery; and those of the old N. East Bastion. Also in pushing on our Gallerys, one of which is now under the Enemys battery, and the other so advanced as to prevent any possibility of destroying the blind by a Mine. We had certain advice this afternoon of Major Caillaud's arrival at the Mount, but no Account of the forces with him. One of the Enemys Ships anchored this Afternoon in St. Thome road, which it was determined the Europe Ship shou'd attack. For if She is loaded with heavy Shells as we apprehend we ought to hazard greatly rather than let them be landed; because the damage they will do the works now the Enemy is so near will be irreparable, and give them an opportunity of effectually establishing the battery on the Glacis.

9th. Early this Morning we heard a smart Canonading towards the Mount which continued at Intervals all Day, and was renew'd very briskly towards the Evening. The Action was no doubt between a strong party of Mr. Lallys European Forces with his black Army, and our Troops under the Command of Major Caillaud who had just join'd Capt. Preston and Usoff Cawn from Tanjore, how it ended is hard to say, but we hope from the repeated reinforcements which the Enemy sent out that our people had the advantage. In the afternoon two Companys of Sepoys were sent out to the Bar and from thence proceeded to the Garden house which posts the Enemy had abandon'd; they found some Ammunition, Sand Bags &c. which they brought away, and set fire to the Enemys Gabions. It was intended that our Europe Ship shou'd make an

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attempt in the night on the Ship which anchord off St. Thomé yesterday, however it was not done, and to Day many stores were unloaded, and carried to the black Town. The Enemys Fire was not very brisk to Day, and most of their Shot flew over the Town. Nothing appeared to have been done at their approaches. Our working Party was last night 51 Pioniers and 27 Sepoys employed in repairing the Demi, and N. East Bastions, and carrying on the Gallerys.

10th. The Enemy last night did nothing apparently to their approaches, and were pretty silent in their Batterys. During the Day they fired smartly from their Northern Battery, but most of the Shot seemed to be directed for the houses in the Town among which they made great havock; they also threw all their Shells into the Town so that the Siege seems to be begun afresh and the Attack intended against the houses rather than the Works. Our Working Party of Pioniers and 48 Sepoys were employed in repairing the old N. East Bastion, the Demi Bastion, clearing the Earth below, and in carrying on the Gallerys. The Enemys Ship went off in the night.

11th. The Enemy last night fired little musquetry, and did not, that we cou'd discover, make any addition to their approaches. The Cuddalore Schooner which came in yesterday in the Evening attempted to destroy a Sloop and Boat of the Enemys to the Southward but by some means we are ignorant of, miscarried. Our Friends lately at the Mount we apprehend have been obliged to quit that Post; and retire towards Chinglaputt; but we hope only thro' want of Ammunition or Provision, and that they will soon return. Our Working Party of 56 Pioniers, and 133 Sepoys were employed in repairing 2 Embrasures, and thickening a Traverse on the Demi-Bastion, in clearing the Rubbish from the Mint Bastion, in laying a Platform and making another Embrasure near the Beach at the Fascine Battery. The Gallery under the Counterscarp being advanced about 95 feet two Chambers were made, and loaded with 250 lb. of Powder each. That before the blind was opened by a Pitt sap thro' the Glacis and a branch carried on a Parallell to the Covered Way towards the Enemy at the Stockadoe.

12th. Last night the Enemy advanced or rather repaired a small breast work they had at the End of the Stockadoe near the Sea side, but made no other alteration in their approaches. Our working Party of 57 Pioniers and 33 Sepoys were employed in repairing the North East Bastion and the Demi, and in lengthening out the Fascine battery quite into the surf by means of Casks filled with Sand, placing a barricade of Pallisadoes, Chevaux de Frize, and Trees in Front, and raising the Parapet. The Pioneers employed under the North Counterscarp continued to stop the Mine, and the blacks to advance the new Shaft. A Deserter came in this forenoon over

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the Enemys Lodgement on the Glacis and assures us that the Enemy are making no Mines; but are much afraid of ours. The fire of the besiegers Artillery and Mortars has not been so brisk to Day as it was yesterday.

13th. This morning between 2 and 3 oClock we were alarmed by an attempt of the Enemy with 30 Europeans and 50 Coffrees to nail up our Guns at the Fascine battery. They advanced along the Sea side from the Stockadoe to within 30 Yards of our Work when being discovered they made an halt, and after receiving a fire or two from a 6 Pounder placed near the beach, they went to the right about in some confusion, and return'd within their works. The Drums having beat to Arms the whole Garrison repaired to their Posts, and plenty of Shells and Grape Shot were thrown into the Enemys approaches. We had a Captain and 1 Soldier wounded, and the Enemy lost 5 or 6 Men whom we saw dead on the beach and in the morning a Serjeant of the Lorraine Regiment being mortally wounded crawled in to our cover'd Way and died soon after. From him we learnt the force, and intention of the Enemy. Our Working Party consisted of 57 Pioniers, and 48 Sepoys who were employed in repairing the N. East Bastion, the Demi-bastion; clearing the rubbish from the North Curtain; and clearing the Earth from the right face of the North Ravelin, with which banquets were made above. The Stopping of the Mine under the North Counterscarp was compleated to day, being intended to destroy the Enemys battery if ever they attempt to reestablish it. The fire of the Enemys North Battery, was to day very brisk, and that at the old hospital silent.

14th. Having observed that the Enemy before the rising of the Moon last night had placed some Gabions near the Sea side a little advanced beyond the Stockadoe, a brisk fire was kept thereon from the Fascine Battery and a Sally resolved to be made in the Morning. Accordingly about 6 o'Clock a Subaltern and 15 Men were sent along the covered Way till they got on the Flank of the Stockadoe, 40 more with 2 Captains went directly in front of the Stockadoe, and 20 with an Engineer went without Arms. The Enemy ran from their Post immediately, and our people took possession which they maintained till the Gabions by the sea side were over turned and thrown into the Surf; The Earth Levelled and the Enemys tools gathered up; our Party then returned having only two men slightly wounded. The Enemy being fired on by the North Ravelin, Royal Bastion, Demi bastion, and Fascine battery with Grape, besides all the works with Musquetry must have lost many men. We cou'd have kept possession of the Stockadoe if we pleased; but such a resolution was not taken. The intent of the Enemy advancing by the sea side must be with a View to bring Cannon against our Fascine Battery, or under cover of the beach which is steep, to advance by means

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of traverses 'till they get beyond our Place of Arms, and then make an attempt on that, and the Fascine battery together. The Enemy were remarkably quiet all night in their Trenches and batterys, the only disturbance they gave us being by a Shell or two now and then; thus they generally act when they are carrying on any work. Our Working Party consisted of 24 Pioniers and 30 Sepoys, who were employed in clearing and repairing the Embrasures of the North East Bastion, repairing the Embrasures on the Demi, and repairing the Caponniere before the blind.

15th. Last night before the rising of the Moon the Enemy replaced the Gabions which had been over sett yesterday morning and endevored to compleat the Traverse (N) but the fire of a 12 pr. from the Fascine Battery, and the Shells from the Demi bastion made such destruction among their Gabions, that they advanced their Work but little. Our Working party of 35 Pioniers and 40 Sepoys was employed in repairing the North East Bastion, the Embrasures of the Demi, One Embrasure on the Royal, the Demi Caponniere before the blind, and driving Pickets in Front of the Fascine Battery. The Mine being loaded three Pioniers attended it by turns, and were covered at night by 10 Grenadiers. The Enemys Fire to Day was very brisk in the Morning from 6 Guns on their Ground battery, 3 at the burying Ground and 2 at the old hospital, but at 5 in the Evening they only fired from 3 at the Grand Battery, and Two at the burying Ground; a great quantity of Artillery indeed to destroy defences! The French Frigate having returned the 14th at night and anchored in St. Thome road the Sailors which we had on Shore and 30 Marines were sent on board the Shaftsbury which sail'd to attack her about 11 at night, but the Frigate was gone out of sight by the morning.

16th. Tho' the Enemy last night did not again attempt to push on their Sap by the Sea side yet we kept a brisk fire till Moon light and by their silence suspected them to be some where at Work. Our people were employed in laying large Timbers, and sand bags on the Beach to make a Plat form at the Fascine Battery for a short Iron 12 pr. of a new make, weighing 11 hundred weight of which 2 came on the Shaftsbury. In driving Pickets in the Front and securing the Flank of the Fascine Battery by Trees laid in the surf. A Party of Sepoys were sent to Levell the Earth at the Foot of the Demi Bastion, but the Moon Rising Early they were discovered, and fired on by the Enemy, who killed one man, and the rest thereon abandoned the Work. The Embrasures of the N. East and Demi Bastion were repaired. The Enemys fire to Day was very brisk from their Artillery, but they threw very few Shells. We got the Platform ready on the beach for the Iron 12 pr. by noon, so that we had 2 Twelves and 1 6 pr. to prevent the Enemys approach. About noon a small Sloop anchord in the road and acquainted us that our Ships

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were seen by her a few Days before in the Latitude 14 N°, and about 5 in the Evening we perceived 6 Sail to the Northward which we concluded to be ours, and apprehending the Enemy on sight thereof might attempt something, the whole Garrison was ordered to lay on their Arms at the several Posts during the Night.

17th. The whole Garrison being at their Posts last night a brisk fire of Musquetry was kept up against the Enemys Works. About 10 o'Clock the 6 Ships seen in the Evening anchored in our Road, and were known to be those we expected from Bombay. A few Pioniers only were employed to lay Plank with Nails drove thro' them in Front of the Fascine Battery. About 2 in the Morning the Enemy fired pretty smartly from Musquetry but their Shot flew high; fires appeared at the same Time in their Trenches, and by Morning we discovered that the approaches were evacuated, and the Enemy were quitting the black Town, having nail'd up all the Guns they cou'd fire from, and destroyed the Carriages which they thought serviceable. *Several of us immediately went into their Works, and were much astonished to see how roughly they had been treated by our Shot and Shells, and how unsupportable the Approaches were had they been vigorously attackd by 2 or 300 men.* The Troops about 600 in Number were landed this morning and appear to be a set of well made Young men. I immediately set about a Survey of the Enemys Trenches that we might proceed to demolish them. Thus terminated the Siege of Fort St. George after the Garrison had been shut up 67 Days and the Enemys Batterys had been open 46. The Arrival of the Ships from Bombay with Succors doubtless hastened the Enemys Retreat and sav'd the black Town, but Mr. Lally for many Days had despair'd of Success, and by his Letter of the 14th (of which a Copy immediately follows) has furnish'd us with an incontestable Proof that the Preservation of our Liberty wou'd have depended on ourselves. An Evidence so valuable to the Garrison that the Satisfaction of knowing the certain Consequences of their gallant Behaviour; exceeded the Pleasure of seeing their Enemy retreat. The hurry of the Scene in which this Journal was wrote, and the nature of the Subject will I hope sufficiently apologize for the stiffness of the stile which can hardly be avoided, in repeated descriptions almost of the same daily occurrences wrote at the Time they happen.

From the Camp before Madrass 14th Febry. 1759.*

A fine Stroke might be made here Sir, there is in this road a Ship of 20 Guns with all the riches of Madrass, on board, and as it is said she is to remain here till the 20th. The Expedition is just arrived, but Mr. Gerlin is not the Man to attack her, since she has already made him run away once. The Bristol on the other Hand, scarce

* Letter from Mr. Lally referred to above.

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appeared at St. Thome but on the uncertain report of the thirteen Ships off Porto Novo he took fright, and after having landed the Stores with which he was loaded, he would not even give himself time to take on Board 12 of his Guns, which he had lent us during the Siege. If I were judge of the Point of Honor of the Company Officers I wou'd break him like Glass as well as some others. Now either the Fidelle, or the Harlem, or this same Bristol, with her other 12 Guns, wou'd be sufficient to take the English Ship if she could get to windward of her, in the obscurity of the night. Maugendra and Tremillior, they say are in very good Condition (son't dit on très bons) and should they only serve to carry off 200 wounded, that we have here, the Service would be important. We yet continue in the same Situation, the breach made these fifteen days, still at thirty Yards from the Walls of the place, and never venturing to look up at it. I imagine when we get back to Pondichery, we shall all set about learning another Trade for that of War requires too much patience, of 1500 Sepoys of which it is judged the Army Consists, I reckon about 800 on the Road to Pondichery loaded with Sugar, Pepper and other Merchandize. As to the Cooleys, they have all been employed to the same purpose, ever since the Day that we arrived here. I shall take my Measures from this day for burning the black Town, and blowing up the Powder Mill. You will never conceive, that 50 French deserters, and about 100 Swiss, shou'd thus keep at Bay 2000 Men of the Kings and Compys. Troops, who are yet here in being, notwithstanding the extravagant Accots., which every one gives according to his own Fancy, of the Slaughter, that has been made of them, and you will be much more surprized, If I Should tell you, that exclusive of the Two Fights, and four Battles that we have had ; and besides the two Batteries, which have failed, or to speak more clearly were built awry we should not have lost 50 Men from the beginning of the Siege to this Day. I have wrote to Mr. De Larche, that if he persists in not coming here, let who will get the Money from the Polygars, it shall not be me, and I renounce, as I apprized you above a Month ago, all concern directly, or indirectly wth. any thing that relates to your administration civil or Military, I wou'd rather go and Command the Coffrees of Madagascar than remain in that *Sodom, which it is impossible but the Fire of the English must sooner or later destroy, If that from Heaven should not.

I have the Honour to be with
perfect Attachment
Your most humble and most obedt. servt.
Lally.

PS : I must apprize you that Mr. De Soupire having refused to take the Command of this Army, which I offered him, and which

* Meaning Pondichery.

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he is authorized to do, by the Duplicate of my Instructions transmitted him from Court, you must, whether you will or not, together with the Council take it upon your selves, I engage only to lead it back for you, either to Arcott or Sadrass, send your orders thither, or come and take the Command your self, for I will quit it as soon as I get there.

Tho' the preceeding part is more properly a Journal of what pass'd in the Engineers Branch than a compleat Journal of the *Siege of Fort St. George*, yet to make it as agreeable and instructive as possible I have constantly remarkd the Enemys proceedings, and interspers'd it with many other the most remarkable Occurrences. I have also added a Return of the Garrison when it was invested, and an abstract of the Number killed wounded taken and deserted during the Siege; together with the Expence of Ammunition and Cannon on both Sides. So that in Substance every thing but tedious Intelligence from Spies, and the literary Correspondence is contain'd herein, that is to be found in the Journal kept with great Care and Pains by the Secretary Mr. Duprè. I shall moreover insert the following Remarks which I have made for the use of my assistants.

From observations on the Enemys Method of proceeding during the Siege, and a Survey of their Works and Batterys after their Retreat, many things have occured worthy a Remark; and tho' they cannot properly claim a Place here, yet as the Intent of keeping Journals is with a View to instruct, and inform Mankind, I believe some lessons may be drawn to our advantage from the Errors committed by our Enemys in the Siege of this place.

First then had Mr. Lally after taking possession of the Garden House forbore some Days the Plunder of the black Town, and amus'd us by reconnoitring and the appearance of batterys to the Southward; our whole Attention wou'd have been taken up to compleat the Lunettes just begun before the South Front, and to put the Works on that Side in the best posture of defence we possibly coud. To deceive us more effectually a few distant shot might have been fired to interrupt the Workmen, and Partys of horse might have been dispos'd in the adjacent Villages to prevent the people from carrying their Effects out of the black Town. As soon as the heavy Cannon and Stores had arrived he might have changed his Situation as easy as he did on the 14th. December, and he wou'd then have found the Works on the North Front in a much worse Condition to oppose him than he did when he first broke ground. Here it must be allowed was great want of Finesse.

But above all is Mr. Lally to be censur'd for Suffering us unmolested to erect in open Day those invincible Obstacles to his Design, the Blind, and Fascine Battery; And besides to let us repair the Embrasures and damaged Merlons, to raise the Saliant Angles,

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build Traverses, and those many additions which we did for near three Weeks to the very Works he intended to Attack, without the least interruption when he might with Cannon and even with Small Arms at no great risque have done us much hurt if not wholly confin'd our working partys to the night.

Impatient of waiting for his Cannon he opened the Batterys with a fire of 13 Guns which left it in our Power to Repair the Damages done by so weak a fire to our Works; whereas had he thundered at once with 25 or 30 pieces of Cannon in the Manner we did . . . .

Advancing by single Zig Zags between Crochets or very Short Demy Parellels to the Top of the Glacis was Mr. Lallys next weak Step; And as if the Approaches were not in themselves sufficiently insupportable they were directed so exactly under the Line of fire from their Grand Battery that on the least Sally the Cannon cou'd not play from thence without a certainty of hurting the Troops posted to defend the Trenches; and they often fired in Reverse into their own Works.

Not Stretching a Parallel at the foot of the Glacis so as to take in the Capital of the Ravelin and embrace the North face of that Work was a neglect unpardonable, which they afterwards thought to remedy by erecting a Battery against that Work, but it was so obliquely situated, and so low that the Guns cou'd hardly throw a Shot into their object, and it was moreover enfiladed by the lower part of our Fascine Battery.

To compleat this Tragedy of Errors, a Battery terrible by its name was opened on the Crest of the Glacis with an Intent to breach the Demy Bastion, but so injudiciously was it construct'd that besides the obliquity of its direction the Guns wou'd hardly bear below our Parapets; and it was so enfiladed from the North Ravelin, plung'd into from the Flank of the Royal Bastion, battered in front by the N. East annoyed by our superior Fire of Musquetry, and so certain a Mark for our heavy Shells and Stones, that it was impossible a Work much better constructed cou'd have been maintain'd under so heavy a Fire.

Carrying a Shaft from the Stockadoe across the cover'd way to the rounding of the Counterscarp and there springing a Fougasse whose aperture was directly opposite the Fire of 6 Guns from the Flank of the Royal, must be deem'd a most injudicious undertaking, if it was intended for any purpose but to terrify by its explosion.

The Direction of the Enemys Fire was I think equally imprudent with the Situation of some of their Batterys: For instead of maintaining a Constant and well laid fire against those objects whose ruin ought to have been their Aim, the Shot from a Single Battery often spread the whole extent of the Polygon; and I believe it may with truth be said, that as many shot struck the Houses or went over the Town, as hit any part of the Works. Their Shells too

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(except two Days) were thrown chiefly into the Town where in some measure they answer'd Mr. Lallys purpose by ruining many buildings, but he must have been very ignorant of our disposition to think the entire destruction of private houses, cou'd have sway'd in any degree the Resolution of the Garrison as to their defence. And one wou'd have imagined a Man of his reputed experience shou'd have known that nothing is more destructive to Earthen Works, or indeed to the Carriages and Troops on all Works, than plenty of heavy Shells thrown amongst them.

But what Surprizes most is, that no Mortars for Stones, Shells, Granadoes or other Artifices were brought up to support the breaching Battery, and incommode the Troops on the North East and Demy Bastions, when at the same time the Enemy suffered so much by a fire of that kind from thence. In short Mr. Lally seem'd to be eagerly desirous to possess the Town without allowing the Time or Materials necessary for the operation and practising that patient method of proceeding which he has since confess'd a Military profession requires.*

By thus pointing out the illconduct of our Enemys in carrying on the Siege, I fear I may seem in some measure to lessen the Merit of the Garrison in their defence; but I hope it will still appear they have very just pretensions to praise. For if the length of the Siege, their hard Duty on Guards, and working partys; the want of Bomb-proof places to rest in be consider'd; together with their Attachement to the Service, Alacrity in the Execution of their Duty, and unanimous Resolution which appear'd in every Face to defend the last Spot of Ground, I say if all these are duely considered, it must be allow'd that every thing was done which cou'd be expected from a brave and faithful Garrison: And yet, I am almost fully persuaded had the besiegers not committed the Several Errors abovemention'd the Works migt. have been so far ruin'd that the Fate of the Town wou'd have depended on the firm Resistance of the Garrison in a general Assault; which I believe woud have been opposed with as much Resolution, as it was expected with firmness.

As nothing very different from what is met with in all Sieges, or laid down as general Maxims was practised in our defence, it will be unnecessary to enter into a particular recapitulation; but I cannot with Justice omit the following Circumstances. To the credit of our Artillery let it be remark'd that two 12 prs. from the North Ravelin dismounted 24 prs. opposed to them, and that of 32 pieces of Cannon found on the Enemys Batterys 31 were disabled by our Shot, which are many more than we had hurt by the Enemy notwithstanding our Works were enfiladed, plung'd into, and taken in reverse; and I doubt not but the destruction of Carriages was equally great. I must also mention as a thing not Common in

* Vide his letter of the 14th Febry.

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Sieges that the Works by a few Men were kept in extraordinary good repair, and three Guns with a Stout Parapet were maintain'd on the North East Bastion from the first to the last Day of the Siege. An Addition was also made of a Battery by the Sea Side and two pieces more were fired the 16th Febry than the 14th December. Nor must I forget to observe that a few raw Men taken from the Pionier Company greatly outdid the much boasted Miners of the French, who were to blow whole Bastions into the Air: For after the breaching Battery was erected those men without having seen any thing of the kind before, and without any previous preparation of Stantions or Tools were set to open the Counterscarp and by continued hard labor carryed a Shaft of 95 feet in length under the Enemys Battery where two Chambers were made and loaded with 250 lb. of Powder each. This Work was executed within a few feet of the Enemy, and in Sight of their Lodgment on the Glacis. They saw, and dreaded; but coud not interrupt it, tho' we lost many men. Whoever considers the nature of the Soil, and that the Shaft was carried on under the explosion of the Enemys Guns which every Day made the Earth fall in, must allow this to have been a most laborious and hazardous undertaking.

Having said thus much of the Errors committed in the Attack, and Remark'd what was uncommon in our defence I will proceed to a particular View of the Enemys Approaches and Batterys as they were the Day the Siege was raised; beginning with that on the Crest of the Glacis.

This Battery opened with 5 Embrasures, three of wch. were intended to breach the Saliant Angle of the Demy Bastion, and two to fire against the blind and North East; but the Construction and position was so ill contrived that the Enemy were obliged to close their Embrasures every Day after firing a few Shot which in general flew over: The havock made in this Battery by our shells and Shot must certainly have been very great; for seven Guns 18 and 24 prs. with their Carriages lay disabled and some of them oversett in a very confus'd manner.

The lodgment on the East Side of the Cover'd Way, and behind the Stockadoe instead of being raised with a thick Parapet wellfaced with Fascines, and Banquets made below, was nothing more than a little lose Earth thrown up into some Gabions placed without Order. Nor were the Crochets or Demy parallels which ought to have been capacious and well made Works, formed in any other manner than the common Zig Zags, which were a kind of flying Sapp about 4 feet broad; so that undoubtedly had it ever been necessary to resolve on attacking the Enemys Trenches with a body of 4 or 500 men we cou'd not have failed to drive them from their grand Battery, and nail up all their Guns.

Near the foot of the Glacis on the face of a Zig Zag was a Battery

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of 4 Embrasures intended to ruin the Parapet and dismount the Guns of the right face of our North Ravelin; but the Allignment of the Parapet was so far from parallel to its object that it was hardly possible to twist the Embrasures into an opening that the Guns might see our Work. Here lay four 24 prs. disabled and their Carriages ruin'd.

On that part of the 2d Crochet to the right of the Zig Zag the Enemy had fired three 8 and 10 Inch Mortars and left behind them two disabled beds, but the Mortars being light they carryed them off the morning of their retreat.

In the grand Battery which opened 15 Embrasures (of which 3 were directed to the North Ravelin and 12 on the Demy and N. East Bastions) were 6 Guns mounted on their Carriages, and tho' the Enemy had fired from four of them the 16th in the Evening, yet all but one had received considerable damage on the Muzzles, and might in fact be reckoned disabled; there were besides 5 Guns with their Carriages and some spare ones dismounted and ruined behind the right wing of this Battery the Enemy for a long time had fired 6 Mortars of 12 French Inches, but afterwards removed them to make room for Guns leaving 2 disabled Beds.

In the Battery a little to the left of the burying Ground which was tolerably well built and opened four Embrasures, were three Guns mounted on their Carriages, which had been fired the preceeding Evening, but were all damaged on their Muzzles. Five Guns in the Battery and one more near lay dismounted and three Carriages by them ruin'd. This Battery to appearance was built with a design to enfilade the right face of the North Ravelin and the Cover'd Way before it, but it was placed a Considerable distance to the left of the face produced and consequently cou'd not answer that purpose, its greatest execution was on the face of the Demy Bastion near the Shoulder against which two Guns constantly played; and the other two so far from having any particular object generally threw their shot at random from the Angle of the Royal to that of the Demy.

On the side of the old Town ditch behind a steep Bank opposite the Portugueese Church were the Remains of four Mortar Platforms, and 2 disabled Beds. And from hence it was the Enemy threw their heavy Shells after they had made their Lodgment on the Crest of the Glacis, because their former Situation there became too hazardous with respect to themselves.

On the Battery to the left of the old hospital vulgarly called Bungarees, and mann'd by the Lorrainers, I cou'd not discover any Guns, but imagine some must have been disabled and buryed or thrown into Wells, which was more likely to be the Case because that Battery was silent several days before the Enemys retreat. It was built among the ruins of houses and had 6 Embrasures, from

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two of which the Enemy for some days battered the left face of the Royal; but afterwards with four only enfiladed the right face and the cover'd Way before it, took the right flank in Reverse, and plung'd into the Demy Bastion adjoining to this Battery on the left was another in a different direction which opened 4 Embrasures, and from whence three Guns were fired on the right face of Pigots Bastion for a few days, after which it was silent, but with what View the Enemy directed any Fire on that Work no one ever cou'd conceive, because that Bastion cou'd neither be attack'd or offend them.

The Battery built in the Front of the New Hospital near the place where the Companys Gardenhouse formerly stood had 4 Embrasures and as many Guns were constantly fired from thence till a few days before the Siege was raised. It was intended I suppose to ricochet and plunge into all the Works of the North Front and indeed it might have proved the most troublesome Battery to us of all which the Enemy erected, but I do not think they had Cannon enough on it, nor that those they had were managed with the greatest address. There were neither Guns nor Carriages found on this Battery and perhaps none were disabled on it, because as the Guns always fired en ricochet the Embrasures were choak'd in Front and the Guns not to be seen.

Upon the whole it is Matter of Astonishment how the Enemy work'd their Guns and Mortars so quick as they did, or how they managed to fire from their Trenches. Instead of Platforms compos'd of Sleepers and Stout Plank they had scarce anything but thin flat roofs of black Houses, or a few unequal pieces of Timber laid in the Earth without being naild or fastened together; and none of these above 9 feet in Length. Their Mortar Platforms were of the same Nature or made of Doors buryed in the ground and a little Straw laid on the top to deaden the Shock. Their Gabions were made of every kind of wood promiscuously and with so little skill that none deserved the name but a few which were made of Rattans. The Fascines in general were little better, except some wch. were made of Coconut leaves, and these I am of opinion wou'd answer extremely well if made with care. The Enemys Carriages (except 6 whose Flanks were very long and consequently must work easy) were so ill shaped, mounted so high and altogether so short, that the impulse of the Trail on the ground was almost in an Angle of 45 degrees, and the weight of the Gun lay so near to the End of the Trail that I am convinced their Artillery cou'd only be managed by great labor and Numbers. Every other apparatus even of the most trivial kind was equally clumsy, ill design'd, and unmanageable. To these then and the other Circumstances above described it certainly is owing that Mr. Lally succeeded no better in his Attack on Madrass and lost so many men in the prosecution of it.

The whole Number of Guns found on the Batterys, left in the black

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Town, at St. Thomé, and other places which are collected together is 52, of which 33 are 18 and 24 prs. the rest 9 prs. or Small Iron field pieces. There were a great many Carriages, Limbers and Tumbrils of different kinds found on the Batterys and in the Park of Artillery, but few of them are serviceable. Out of the Tanks, Wells, Surf, and scattered on the ground, were collected many thousand shot of Sizes, which added to those found in the Town and Works will more than replace the quantity we fired during the Siege. Powder in Casks, and flannell Bags was found in abundance carelessly scattered about the Batterys and Trenches, from whence we may easily account for the frequent explosions our shot and Shells occasioned. At St. Thomé and in the black Town were found 150 Barrels of good Powder and as many Casks of Ammunition but great part of the latter was damaged. Many other Military Stores were pick'd up which the Enemys precipitate Retreat, wou'd not allow them time to destroy. Nor wou'd they have been able to accomplish their design on the Powderhouse, but that it had been made a Magazine, and there was then lodg'd in it a considerable quantity of Powder and Cartridges. These they set fire to about 8 in the Morning, and effectually shook down the whole Building; but the operation was so hastily performed that the Gunners who fired the Train had not time to escape, and were crush'd to death by the fall of the Walls.

The Houses in the black Town were not hurt much more than what happened in the Course of the Siege from our Shot, or for the Enemys convenience, altho' Mr. Lally says in his intercepted Letter of the 14th Febry. that he shou'd take measures to destroy it, and tis not to be doubted, but he wou'd have kept his word, had he been more at Leisure. A Step of this kind however cruel it appears, the Customs of War might warrant; for by destroying the houses of the black Inhabitants, Numbers wou'd have been reduced to extreme Poverty, and having no longer Possessions Support, but from daily labor, wou'd have retired to Places where they had a better chance to live unmolested: The Company consequently must have suffered, but it was pitiful, and mean to damage, and intend the total destruction of the Governors Garden house, the Houses of Private Gentlemen at the Mount, and other places near Madrass. It is true the destruction of these Buildings was a loss to the owners but in no degree prejudicial the Company or the Commerce of the Settlement. The only inconvenience was to a few Gentlemen who as their leisure permitted, or health required, spent a Day or a Week in the Country for the benefit of the Air.

Not such was the Treatment of the conquered at Chandernagore; Private houses were not only left unhurt, but many of those which had received inevitable Damage in the Siege were repaired, and the owners suffered to reside in them with their effects. But what

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better cou'd we expect from a Commander whose Barbarity to his own people was such, that he left 44 miserable wretches in an hospital without a Single Person to assist them; and without having the good manners, or humanity, to leave a Line requesting our Care. Good nature in us supplyed the want of it in him, and the Enemys wounded were treated on a footing with our own. It certainly can be no agreeable Task to enumerate the many Instances of ill treatment from an Enemy; on the contrary it would be a pleasure to receive Favors from them to make acknowledgments, and to have occasions of returning the Civility. Nations from Political Motives engage in War particulars manage it; and tho' ordered to kill, slay, and destroy, would gain more honor by acting with Lenity when conquerors, than by treating the conquered with rigor.

LIST OF THE OFFICERS KILLED AND WOUNDED IN THE SIEGE OF FORT ST. GEORGE, 1759.

Killed.

Major	Paul Polier	of the Companys Infantry.
Captains	John Hume	do.
	Augustus Monchanin	do.
Capt. Lieutenants	Stephen Bilhock	do.
	Jonathan Brooke	Companys Artillery.
Lieutenants	William Robson	Companys Infantry.
	John Little	do.
	Joseph Bales	do.
	Brown	64 Regiment.
Ensigns	Richard Chace	Companys Infantry.
	Schomborg	do.
	William Barnes	do.
	James Belton	do.
	Dead of Sickness, Capt James Ogilvy	do
15	Lieut Fireworker John Teal, Royal Artillery.	

Wounded.

15		
Captains	Richard Black	of the Companys Infantry.
	Edmund Pascall	do.
	Charles Todd	do.
Lieutenants	William Elliot	do.
	Ross Lang	do.
	Leonard Parrott	do.
	John Hopkins	64 Regiment.
	Archibald Blair, Stephen Smith	Prisoners Companys Infantry.
2nd Lieutenant	Edgar Wietman	Royal Artillery.
Ensigns	Richard Fitzpatrick	Comps. Infantry.
	John Billingham	Comps. Infantry.
	Thomas Wilcox	Comps. Infantry.
Ensign	Richard Cook made Prisoner,	
14	but left behind among the	
—	Enemys Sick when they	
K. and W. 29	retreated	do.

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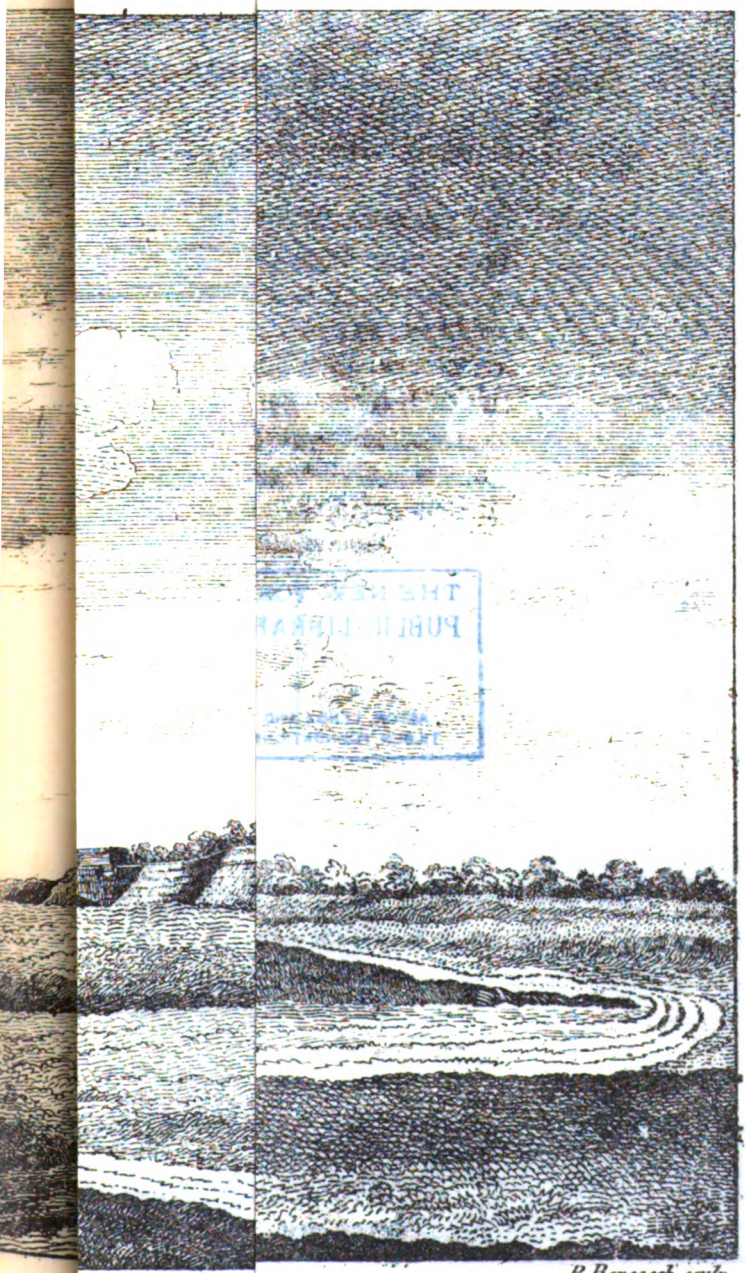

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SIEGES AND THE DEFENCE OF FORTIFIED PLACES BY THE BRITISH AND INDIAN ARMIES IN THE XIXth CENTURY.

(*Continued*).

By COLONEL SIR EDWARD T. THACKERAY, V.C., K.C.B. (LATE R.E.).

THIRD BRITISH SIEGE OF BADAJOZ, *March*, 1812.

After the capture of Ciudad Rodrigo, Lord Wellington was once more in a position to turn his attention to Badajoz. It was known that Marmont's battering train had been captured in Rodrigo, and for this reason an irruption of the French into Portugal during the absence of the Allies could be attended with no permanent ill-effects, as they had no heavy artillery with which to reduce either Ciudad Rodrigo or Almeida. Towards the end of January therefore Lieut.-General Leith with the 5th Division marched into Rodrigo to form a garrison whilst the defences were repaired and strengthened, and on the 5th of March, the breaches having been rendered perfectly defensible and the place having been in some degree provisioned, it was finally handed over to the Spaniards. Meanwhile preparations for the attack on Badajoz were secretly proceeding: the battering train and Engineers' stores were embarked at Lisbon for a fictitious destination, transferred to smaller vessels at sea, landed at Alcacer do Sal, and thence transported overland to Elvas. Fascines and gabions were also made at Elvas as if intended for the works there, and every preparation was pushed on for the final attack on the fortress. On the 16th of March all was in readiness for the siege; the 3rd and 4th Divisions crossed the Guadiana by a pontoon bridge which had been thrown across the river some 4 miles below the town, and invested Badajoz without meeting with any opposition from the enemy.

The fortress itself was garrisoned by a mixed force of French, Russian and Spanish troops, 5,000 in all including sick, and a reconnaissance showed that it had been greatly strengthened since the attack of the preceding year. Phillipon making himself felt in every direction, had scoured the vicinity of the place, destroyed

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many small bands, carried off cattle almost under the guns of Elvas and Campo Mayor, and his spies were abroad from Ciudad Rodrigo to Lisbon and from Lisbon to Ayamonte. He had made an interior retrenchment in the castle and augmented the number of its guns; the rear of Fort Christoval was also better secured, and a covered communication from the fort itself to the work at the bridgehead was nearly completed. Two ravelins were constructed on the south side of the town, a third was commenced, and likewise counter-guards for the bastions; but the eastern front next the castle, which was in other respects the weakest point, was without any outward protection save the stream of the Rivillas. A "cunette" or second ditch had been dug at the bottom of the great ditch, which was also in some parts filled with water; the gorge of the Pardalleras was enclosed, and the work connected with the body of the place from whence powerful batteries looked into it. The three western fronts were mined, and on the east the San Roque Bridge was built up to form an inundation 200 yards wide, which greatly contracted the space by which the place could be approached. All the inhabitants had been ordered to lay up food for three months, and two convoys with provisions and ammunition had entered the place on the 10th and 16th of February; the stores of powder and supply of shells were, however, inadequate.

Wellington finding the old attack against Christoval impracticable, desired to assail one of the western fronts, which would have been scientific; but the Engineers pointed out that he had neither mortars, miners, nor guns, nor the means of bringing up sufficient stores for such an attack. Indeed the want of transport had again forced the Allies to draw stores from Elvas to the manifest hazard of that fortress, and hence here, as at Ciudad Rodrigo, time was necessarily paid for by loss of life, or rather the crimes of the politicians were atoned for by the blood of the soldiers. It was finally resolved to attack the bastion of Trinidad because, the counter-guard there being unfinished, that bastion could be battered from the hill on which the Picurina stood. The first parallel was to embrace the Picurina, the San Roque, and the eastern front in such a manner that counter-batteries might destroy all the armament of the southern fronts which bore against the Picurina Hill. The Picurina itself was to be battered and stormed, and from thence the Trinidad and Santa Maria Bastions were to be breached. All the guns were then to be turned to open a third breach in the connecting curtain which was known to be of weak masonry, and thus a storming party could turn any retrenchment behind the great breaches. In this way the inundation could be avoided, and, although a French deserter declared that the ditch was 18 ft. deep at this point, such was the General's confidence in his troops that he resolved to storm the place without blowing in the counterscarp.

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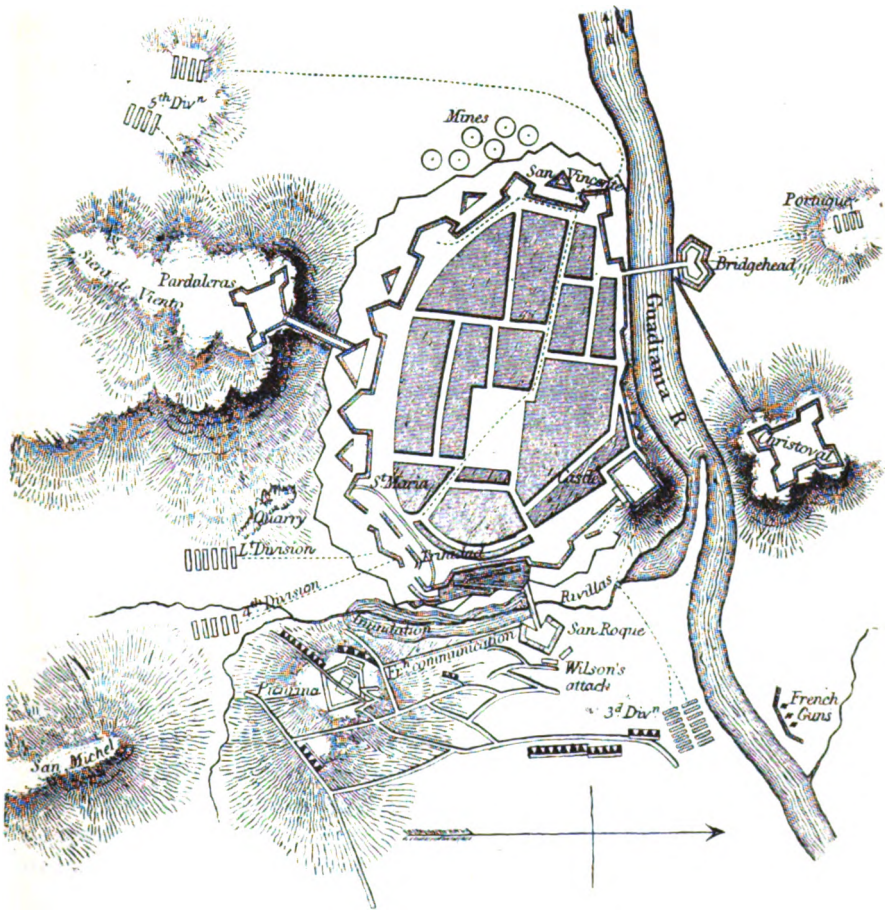
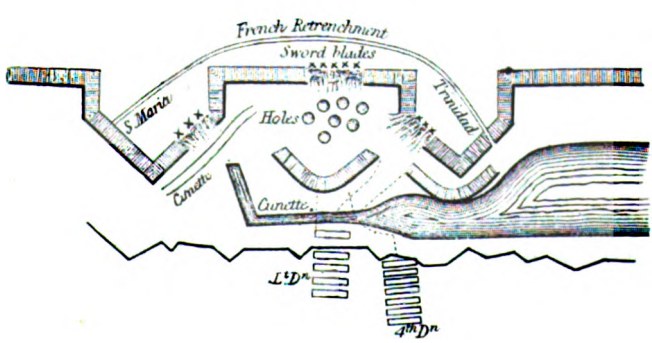
SIEGE OF

BADAJOS

1812



PLAN OF BREACHES



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Dickson's battering train of 52 pieces included sixteen 24-pound howitzers for throwing shrapnel shells, but this missile was little prized by Wellington, and partly to avoid expense, partly from a dislike to injure the inhabitants, neither in this nor in any siege did he use mortars.

Of 900 gunners present 300 were British, the rest Portuguese, and there were 150 sapper volunteers from the 3rd Division, not skilful but of signal bravery. The Engineers' Park was behind the heights of St. Michael. Picton had direction of the siege—Colville, Kempt, and Bowes alternately commanded in the trenches—the Engineer officers Burgoyne* and Squire conducted the attack, and during the night of the 17th, 1,800 men, protected by a guard of 2,000, broke ground 160 yards from the Picurina. A tempest stifled the sound of the pickaxes, and, though the work was commenced late, a communication 4,000 ft. in length was formed and a parallel 600 yards long, 3 ft. deep, and 3 ft. 6 in. wide was opened. When day broke the Picurina was reinforced, and a sharp musketry interspersed with discharges from some field pieces aided by heavy guns from the body of the place was directed on the trenches.

In the night of the 18th two batteries were traced out, the parallel was prolonged right and left, and the previous works were improved. The garrison raised the parapets of the Picurina, lined the top of the covered way with sandbags and planted musketeers to gall the men in the trenches, who replied in a like manner.

On the 19th, Wellington having secret intelligence that a sally was intended, ordered the guards to be reinforced. Nevertheless at 1 o'clock some cavalry came out by the Talavera Gate, and 1,300 infantry under General Viellande, filed unobserved into the communication between the Picurina and the San Roque—100 men were prepared to sally from the Picurina itself, and all these troops jumping out at once drove the workmen before them and began to demolish the parallel. Previous to this outbreak the French cavalry had divided and commenced a sham fight on the right of the parallel, the smaller party, pretending to fly and answering Portuguese to the challenge of the piquets were allowed to pass, and, elated by the success of this stratagem, galloped to the Engineers' Park, 1,000 yards behind the trenches, where they cut down a few men before help came. Meanwhile the troops at the parallel having rallied upon the relief which had just arrived beat the enemy's infantry back even to the castle. In this hot fight the besieged lost above 300 men and officers, the besiegers only 150, but Colonel Fletcher, Chief Engineer, was badly wounded and several hundred entrenching tools were carried off, for Phillipon had promised a high price for each; yet this turned out ill as the soldiers neglected the fight to gather tools.

* Afterwards Field Marshal Sir John Burgoyne, G.C.B.

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After the action a reserved squadron of dragoons and six field pieces were always stationed behind St. Michael, and a signal post was established to give notice of the enemy's movements.

Wet and boisterous weather harassed the workmen, flooded the trenches, and retarded progress, but on the 19th the parallel was entirely opened, and on the 20th enlarged; next night it was extended across the Seville road and three counter-batteries were commenced.

On the 20th a slight sally had been repulsed, and during the night another battery against the San Roque was commenced and the battery against the Picurina was finished. Yet heavy rain again retarded the works, and the besiegers, having failed in an attempt to drain the lower parts of the parallel by cuts, made an artificial bottom of sandbags. The besieged, thinking the curtain adjoining the castle was the true object of attack, threw up an earthen entrenchment in front, and commenced clearing away the houses behind it.

Vauban's maxim that a preliminary investment is the first requisite in a siege had been neglected at Badajoz to spare labour, but the great master's art was soon vindicated by his countryman, Phillipon finding the right bank of the Guadiana free, made a battery in the night for three field pieces and at daylight raked the trenches: the shots pitching into the parallel swept it in the most destructive manner for the whole day, and the loss would have been terrible if the soft nature of the ground had not prevented the ricochet of the bullets. Orders were immediately sent to the 5th Division, then at Campo Mayor, to invest the place on that side, but these troops were distant and misfortunes accumulated. In the evening rain filled the trenches, the flood of the Guadiana sank twelve of the pontoons of the fixed bridge and broke the tackle of the flying bridges; the provisions for the army could not then be brought over, the guns and ammunition were on the right bank and the siege was on the point of being raised. In a few days, however, the river subsided, some Portuguese craft were brought up to form a flying bridge, the pontoons saved were employed as rowboats, and the communication was thus secured for the rest of the siege without accident.

On the 23rd the besieged were working on their entrenchment covering the front next the castle, and the besiegers were fixing platforms, when at 3 o'clock sudden rain filled the trenches, saturated earth fell away, the works crumbled, and the attack was entirely suspended. Next day the place was invested beyond the Guadiana by the 5th Division, and the weather being fine the batteries were armed with ten 24-pounders, eleven 18-pounders, and seven 5½-in. howitzers, all of which opened on the 25th; they were vigorously answered, and a howitzer was dismounted and several

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artillery and Engineer officers were killed. Nevertheless the San Roque was silenced, the Picurina garrison so galled by the marksmen that none dared to look over the parapet, and as the external appearance of that fort did not indicate great strength General Kempt was ordered to assault. The outward seeming was, however, very fallacious, the fronts were well covered by the glacis, the flanks deep, the rampart at 14 ft. from the bottom of the ditch was protected with thick slanting palings, and above them there was an earthen slope of 16 ft. A few palings had been knocked off the covered way and the parapet was slightly damaged, but it was repaired with sandbags and the ditch was profound, narrow at the bottom, and flanked by four splinter-proof casemates. Seven guns were mounted, the entrance by the rear was protected by three rows of thick paling, and the garrison was 200 strong—every man having two muskets. The top of the rampart was garnished with loaded shells to push over, a retrenched guard-house formed a second internal defence, and small mines and a loopholed gallery under the counterscarp, intended to take the assailants in rear, were begun, but not finished.

Five hundred men of the 3rd Division assembled for the attack. Kempt ordered 200 under Major Rudd, of the 77th, to turn the fort on the left—an equal force under Major Shaw, of the 74th, to turn the fort by the right—and 100 men from each of these bodies were to enter the communication with San Roque, and intercept succour coming from the town. The flanking columns were to make a joint attack on the fort, and the hundred men remaining formed a reserve under Capt. Powis, of the 83rd. The Engineers, Holloway, Stanway, and Gipps, having 24 Sappers bearing hatchets and ladders, guided these columns, and 50 of the Light Division provided with axes were to move out of the trenches at the moment of attack.

Assault of Picurina.

At 9 o'clock, the night being fine and the arrangements skilfully made, the two flanking bodies moved forward. The distance was short and the troops quick, but the fort black and silent before, now seemed a mass of fire. The assailants running to the palisades in the rear with undaunted courage endeavoured to break through, and, where the destructive musketry and the thick pales rendered their efforts useless, they strove to get in by the faces of the work, yet the depth of the ditch and the slanting stakes still baffled them. The enemy also shot fast and fatally, and the crisis being imminent Kempt sent the reserve headlong against the front ; then the fight and the carnage became terrible, and a battalion coming out from the town to the succour of the fort was encountered and beaten by the party on the communication. The guns of Badajoz and the castle now opened, the guard of the trenches replied with musketry,

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rockets were thrown up by the besieged, and the shrill sound of alarm bells mixed with the shouts of the combatants increased the tumult. Still the Picurina sent out streams of fire by the light of which dark figures were seen struggling on the ramparts ; for Powis had escaladed where the artillery had beaten down the pales, and the other assailants throwing ladders in the manner of bridges from the brink of the ditch to the slanting stakes also mounted, and all were fighting hand to hand.

The axe-men of the Light Division, compassing the fort like prowling wolves, soon discovered the gate and hewing it down broke in by the rear, but the struggle still continued. Powis, Holloway, Gipps, and Oates, of the 88th, fell wounded on or beyond the rampart—Nixon of the 52nd was shot 2 yards within the gate—Shaw, Rudd, and nearly all the other officers had fallen outside—and it was not until half the garrison were killed that Gaspar Thiery, the Commandant, surrendered with 86 men ; the others rushing out of the gate endeavoured to cross the inundation and were drowned.

Phillipon thought that the Picurina would have delayed the siege five or six days, and had the assault been a day later this would have happened ; for the loopholed gallery in the counterscarp and the mines would then have been completed, and the body of the work was too well covered by the glacis to be quickly ruined by fire. He was baffled by this heroic assault which lasted an hour, and cost 4 officers and 40 men killed, 15 officers and 250 men wounded, and so vehement was the fighting, that the garrison had not time to roll over the shells and combustibles arranged on the parapet.

When the Picurina was taken three battalions advanced to secure it, and though a great turmoil and firing from the town continued until midnight, a lodgment in the works and communication with the first parallel were established, and the second parallel was commenced ; yet at daylight the redoubt was so overwhelmed with fire from the town that no troops could remain and the lodgment was entirely destroyed. In the evening the Sappers effected another lodgment on the flanks, the second parallel was then opened in its whole length, and the next day the counter-batteries on the right of the Picurina exchanged a vigorous fire with the town, by which one of the besiegers' guns was dismounted.

In the night of the 27th a new communication from the first parallel to the Picurina was made, and three breaching batteries were traced out ; one for twelve 24-pounders, to breach the right face of the Trinidad Bastion, occupied the space between the Picurina and the inundation ; a second for eight 18-pounders, to breach the left flank of the Santa Maria Bastion, was on the site of the Picurina ; a third on the prolonged line of the front to be attacked contained three shrapnel howitzers to scour the ditch and prevent the garrison working in it. At daybreak these works furnished with gabions and sandbags,

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were lined with musketeers who galled the workmen employed on the breaching batteries, and the cannonade was brisk on both sides. Two of the besiegers' guns were dismantled, the gabions placed in front of the batteries to protect the workmen were knocked over and the musketry became so destructive that the men were withdrawn from the front and threw up earth from the inside.

On the night of the 27th the second parallel was extended to the right, with the view of raising batteries to ruin San Roque, destroy the dam that held up the inundation, and breach the curtain behind; but the Talavera road proved hard, and the moon shone so brightly that the labourers were quite exposed and the work was relinquished. On the 28th the screen of gabions before the batteries was restored, the workmen renewed their labours outside, the parallel was improved and the besieged withdrew their guns from San Roque. Yet their marksmen still shot from it with great exactness, and the plunging fire from the castle dismounted two howitzers in one of the counter-batteries which was therefore dismantled. The enemy had also during the night observed the tracing string which marked the direction of the sap in front of San Roque, and a daring fellow, creeping out just before the workmen arrived, brought it in the line of the castle fire whereby some loss was sustained ere the false direction was discovered.

In the night the dismantled howitzer battery was re-armed with 24-pounders to play on the San Roque, and a new breaching battery was traced out on the site of the Picurina against the flank of the Santa Maria Bastion. The second parallel was also carried by the sap across the Talavera road, and a trench excavated for riflemen in front of the batteries.

On the 29th, a slight sally made on the right bank of the river was repulsed by the Portuguese, but the sap at San Roque was ruined by the enemy's fire, and the besieged continued to raise the counter-guard and ravelin of the Trinidad and strengthen the front attacked. The besiegers armed two batteries with 18-pounders which the next day opened against Santa Maria with but little effect, and the explosion of an expense magazine killed and hurt many men.

During the siege Soult, having little fear for the town yet expecting a great battle, was carefully organizing a powerful force to unite with Drouet and Danican. These generals had occupied the district of La Serena to keep open the communication with Marmont by Medillo and Truxillo; but Graham and Hill forced them into the Morena, while Morillo and Penne Villemur, lying close on the Lower Guadiana waited an opportunity to fall on Seville when Soult should advance; and there were other combinations to embarrass the French Marshal.

Marmont was concentrating his army in the Salamanca country, and it was rumoured he meant to attack Ciudad Rodrigo. Wellington was disturbed by this information. The flooding of the rivers

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would prevent a blockade and he knew Marmont had not obtained a battering-train; but the Spanish generals and Engineers had neglected the new works of Ciudad Rodrigo; Almeida was in a bad state, and the project of invading Andalusia was likely to be stopped by these embarrassments.

On the 30th it became known that Soult was coming from Cordova. Then the 5th Division was brought over the Guadiana, Power's Portuguese Brigade and some cavalry only being left to maintain the investment on the right bank, and the siege was urged vehemently. Forty-eight pieces were in constant play and the sap against San Roque advanced; yet the enemy was equally diligent, his fire was destructive and his ravelin and counter-guard on the menaced front visibly advanced. By the 1st of April the sap was close to San Roque, the Trinidad crumbled, and the flank of the Santa Maria which was casemated and had hitherto resisted the batteries, also began to yield. By the 2nd, the face of the Trinidad was very much broken, but at the Santa Maria, the casemates being laid open, the bullets were lost in the cavities, and the garrison commenced a retrenchment to cut off the whole of the attacked front from the town.

During the night, a new battery against the San Roque being armed, two officers and some Sappers glided behind that outwork, gagged the sentinel, placed powder barrels and a match against the dam of the inundation, and retired undiscovered; yet the explosion did not destroy the dam and the inundation remained. Nor did the sap make much progress because of the French musketeers; for though the marksmen sent against them slew many, they were reinforced by means of a raft with parapets which crossed the inundation, and men also passed by the communication from the Trinidad Gate.

On the 3rd, guns were turned against the curtain behind the San Roque, but the masonry proved hard, ammunition was scarce, and as a breach there would have been useless while the inundation remained, the fire was soon discontinued. The breaches in the bastion were now greatly enlarged, and the besieged assiduously laboured at the retrenchments behind them, and converted the nearest houses and garden walls into a third line of defence. All the houses behind the front next the castle were also thrown down, and a battery of five guns intended to flank the ditch and breach of the Trinidad was commenced on the castle hill outside the wall; the besiegers therefore traced a counter-battery of 14 shrapnel howitzers to play upon that point during the assault, and the crisis was fast approaching. The breaches were nearly practicable, but Soult having joined Drouet and Danican, was advancing, and as the Allies were not in sufficient force to assault the place and give battle at the same time, it was resolved to leave two divisions in the trenches and fight at Albuera: Graham therefore fell back towards that place, and Hill, destroying

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the bridge at Merida, marched from the Upper Guadiana to Talavera Real.

To gain time being now, as in war it generally is, the essential ingredient of success, the anxiety on both sides redoubled, yet Soult was still at Llerina on the morning of the 5th when the breaches were declared practicable. The assault was therefore ordered ; but though Leith's Division was brought up to assist, a very careful personal examination caused such doubts in Wellington's mind that he delayed until a third breach should, as he originally designed, be opened between the Trinidad and Maria Bastions. This could not be commenced before morning, and in the night the enemy laboured assiduously behind the openings, regardless of the showers of grape with which the batteries scoured the ditch and breaches. Next morning the guns were turned against the Trinidad curtain, and the bad masonry crumbled so fast that in two hours a yawning break was seen, and Wellington having again examined the points of attack renewed his orders for the assault. Then the soldiers eagerly made ready for a combat, so fiercely fought, so terribly won, so dreadful in all its circumstances that posterity can scarcely be expected to credit the tale.

So sensible was the English General of Phillipon's firmness and the courage of his garrison that he spared them the affront of a summons, yet, seeing the breach strongly entrenched and the enemy's flank fire still powerful, he would not in this dread crisis trust his fortune to a single effort. Eighteen thousand daring soldiers burned for the signal, and he, unwilling to lose the services of one, gave to each division a task such as few generals would have the hardihood even to contemplate. For on the right Picton was to file out of the trenches, cross the Rivillas River and scale the castle walls, 18 to 24 ft. in height, furnished with all means of destruction and so narrow at top that the defenders could easily reach and overturn the ladders. On the left Leith was to make a false attack on the Pardaleras, but a real assault on the distant bastion of San Vincente, where the glacis was mined, the ditch deep, the scarp 30 ft. high, and the parapet held by bold troops provided each with three loaded muskets that the first fire might be quick and deadly.

In the centre, the 4th and Light Divisions, under Colville and Andrew Barnard, were to march against the breaches. They were furnished like the 3rd and 5th Divisions with axes and ladders, and preceded by storming parties of 500 men each with their respective forlorn hopes ; the Light Division was to assault the bastion of Santa Maria, the 4th Division to assault the Trinidad and the curtain, and the columns were divided into storming and firing parties, the former to enter the ditch the latter to keep the crest of the glacis.

At first only one brigade of the 3rd Division was destined to

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attack the castle, but just before the assault a sergeant of Sappers deserted from the French and reported that there was but one communication from the castle into the town, wherefore the whole division was directed to assail in mass.

To aid these great attacks General Power's Portuguese were to make a feint from the other side of the Guadiana, and Major Wilson, of the 48th, was to storm the San Roque with the guards of the trenches; this general outline was filled up with many nice arrangements, some of which were followed, others disregarded, for it is seldom all things are attended to in a desperate fight. Nor was the enemy idle. While it was yet twilight some French cavalry issued from the Pardaleras, escorting an officer who endeavoured to look into the trenches with a view to ascertain if an assault was intended; but the piquet on that side jumped up, and firing as it ran drove him and his escort back into the works. Then darkness fell and silently the troops awaited the signal.

Assault of Badajoz.

Dry but cloudy was the night, the air thick with river mist, the ramparts and the trenches unusually still; yet a low murmur pervaded the latter, and in the former the lights were seen to flit here and there while the deep voices of the sentinels at times proclaimed that all was well in Badajoz. The French, confiding in Phillipon's well-known skill, watched from their lofty station the approach of enemies whom they had twice before baffled, and now hoped to drive a third time blasted and ruined from the walls. The British standing in deep columns were as eager to meet that fiery destruction as the others were to pour it down, and both were alike terrible in their strength, their discipline, and the passions awakened in their resolute hearts. Former failures there were to avenge, and on both sides leaders who furnished no excuse for weakness in the hour of trial. The possession of Badajoz had become a point of personal honour with the soldier of each nation, but the desire for glory with the British was dashed by a hatred of the citizens on an old grudge; and recent toil and hardship with much spilling of blood had made many incredibly savage. The wondrous power of discipline bound the whole together as with a band of iron, and in the pride of arms none doubted their might to bear down every obstacle that man could oppose to their fury.

At 10 o'clock the castle, the San Roque, the breaches, the Pardaleras, the distant bastion of San Vincente were to have been assailed simultaneously, and it was hoped the strength of the enemy would weaken within that fiery girdle. But many are the disappointments of war. An unforeseen accident delayed the attack of the 5th Division, and a lighted carcass thrown from the castle, falling close to the 3rd Division led to its discovery and compelled the troops to

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anticipate the signal by halt an hour. Then, everything being suddenly disturbed, the double columns of the 4th and Light Divisions also moved silently and swiftly against the breaches, and the guard of the trenches rushing forward with a shout encompassed the San Roque with fire, and broke in so violently that scarcely any resistance was made.

But a sudden blaze of light and the rattling of musketry indicated the commencement of a more vehement combat at the castle. Picton, having been hurt by a fall in the camp and expecting no change in the hour, was not present, and consequently General Kempt led the 3rd Division. Having passed the Rivillas in single files by a narrow bridge under a terrible musketry fire he had re-formed, and running up a rugged hill reached the foot of the castle, where he fell severely wounded, and as he was carried back to the trenches met Picton who was hastening to take the command. Meanwhile the troops spreading along the front had reared their heavy ladders, some against the lofty castle, some against the adjoining front on the left, and with incredible courage ascended amidst showers of heavy stones, logs of wood and bursting shells rolled off the parapet, while from the flanks the enemy plied his musketry with fearful rapidity, and in front with pikes and bayonets stabbed the leading assailants or pushed the ladders from the walls, and all this was attended with deafening shouts and the crash of breaking ladders, and the shrieks of crushed soldiers answering to the sullen stroke of the falling weights.

Still swarming round the remaining ladders those undaunted veterans strove to be the first to climb, until all being overturned the French shouted victory, and the British, baffled but untamed, fell back a few paces and took shelter under the rugged edge of the hill. There, the broken ranks were somewhat re-formed, and the heroic Ridge springing forward seized a ladder and calling with stentorian voice on his men to follow, once more raised it against the castle, yet to the right of the former attack where the wall was lower and an embrasure offered some facility. A second ladder was soon placed alongside of the first by the Grenadier Officer Canch, and the next instant he and Ridge were on the rampart, the shouting troops pressed after them, the garrison amazed and in a manner surprised were driven fighting through the double gate into the town and the castle was won. A reinforcement from the French reserve then came up, a sharp action followed, both sides fired through the gate and the enemy retired.

All this time the tumult at the breaches was such as if the very earth had been rent asunder. The two divisions had reached the glacis just as the firing at the castle commenced, and the flash of a single musket discharged from the covered way as a signal showed them that the French were ready ; yet no stir was heard and darkness

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filled the breaches. Some hay-packs were thrown, some ladders placed, and the forlorn hopes and storming parties of the Light Division, 500 in all, descended into the ditch without opposition; but then a bright flame shooting upwards disclosed all the terrors of the scene. The ramparts crowded with dark figures and glittering arms were on one side, on the other the red columns of the British, deep and broad, were coming on like streams of burning lava; it was the touch of the magician's wand, for a crash of thunder followed and with incredible violence the storming parties were dashed to pieces by the explosion of hundreds of shells and powder barrels.

For an instant the Light Division stood on the brink of the ditch amazed at the terrific sight, but then with a shout that matched even the sound of the explosion the men flew down the ladders, or disdaining their aid leaped reckless of the depth into the gulf below—and at the same moment amidst a blaze of musketry that dazzled the eyes, the 4th Division came running in and descended with a like fury. There were only five ladders for the two columns which were close together, and a deep cut made in the bottom of the ditch was filled with water from the inundation; into that watery snare the head of the 4th Division fell, and it is said that above a hundred of the Fusiliers—the men of Albuera—were drowned in it. Those who followed checked not, but, as if such a disaster had been expected, turned to the left, and then came upon the face of the unfinished ravelin which being rough and broken was mistaken for the breach and instantly covered with men; yet a wide and deep chasm was still between them and the ramparts, from whence came a deadly fire wasting their ranks. Thus baffled they also commenced a rapid discharge of musketry and disorder ensued; for the men of the Light Division, whose conducting Engineer had been disabled early and whose flank was confined by an unfinished ditch, rushed towards the breaches of the curtain and the Trinidad, which were indeed before them but which the 4th Division had been destined to storm. Great was the confusion, for the ravelin was quite crowded with men of both divisions, and while some continued to fire others jumped down and ran towards the breach; many also passed between the ravelin and the counter-guard of the Trinidad, the two divisions got mixed, the reserves which should have remained at the quarries also came pouring until the ditch was quite filled, the rear still crowding forward and all cheering vehemently. The enemy's shouts were also loud and terrible, and the bursting of shells and grenades, the roaring of guns from the flanks, answered by the iron howitzers from the battery of the parallel, the heavy roll and horrid explosion of the powder barrels, the whirring flight of the blazing splinters, the loud exhortations of the officers, and the continued clatter of the muskets made a maddening din.

Now a multitude surged up the great breach as if driven by a

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whirlwind, but across the top glittered a range of sword-blades, sharp-pointed, keen-edged on both sides, and firmly fixed in ponderous beams chained together and set deep in the ruins; and for 10 ft. in front the ascent was covered with loose planks studded with sharp iron points, which moved when any attempt was made to cross them and the soldiers falling forward on the spikes rolled down upon the ranks behind. Then the Frenchmen, shouting at the success of their stratagem and leaping forward, plied their shot with terrible rapidity, for every man had several muskets, and each musket in addition to its ordinary charge contained a small cylinder of wood stuck full of wooden slugs, which scattered like hail when they were discharged. Once and again the assailants rushed up the breaches, but always the sword-blades, immovable and impassable, stopped their charge, and the hissing shells and thundering powder barrels exploded unceasingly. Hundreds of men had fallen, hundreds more were dropping; still the heroic officers called for new trials, and sometimes followed by many, sometimes by a few, ascended the sides, and so furious were the men themselves that in one of these charges the rear strove to push the foremost on to the sword-blades willing even to make a bridge of their writhing bodies, but the others frustrated the attempt by dropping down; and men fell so fast from the shot, that it was hard to know who went down voluntarily and who were stricken, and many stooped unhurt who never rose again.

At the beginning of this dreadful conflict, Andrew Barnard had with prodigious efforts separated his division from the other and preserved some degree of military array; but now the tumult was such that no command could be heard distinctly except by those close at hand, and the mutilated carcasses heaped up on each other and the wounded struggling to avoid being trampled upon broke the formations, order was impossible. Officers of all ranks, followed more or less numerously by the men, were seen to start out as if struck by sudden madness and rush into the breach which yawning and glittering with steel seemed like the mouth of a huge dragon belching forth smoke and flame. Gathering in dark groups and leaning on their muskets the troops looked up in sullen desperation at the Trinidad, while the enemy stepping out on the ramparts, and aiming their shots by the light of the fire-balls which they threw over, asked as their victims fell, why they did not come into Badajoz.

In this dreadful situation, while the dead were lying in heaps and others continually falling, the wounded crawling about to get some shelter from the merciless shower above, and withal a sickening stench from the burnt flesh of the slain, Capt. Nicholas, of the Engineers, was observed by Lieut. Shaw, of the 43rd, making incredible efforts to force his way with a few men into the Santa Maria Bastion. Shaw immediately collected 50 soldiers of all regiments and joined him, and although there was a deep cut along the foot of that breach

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also, it was instantly passed and these two young officers led their gallant band with a rush up the ruins; but when they had gained two-thirds of the ascent a concentrated fire of musketry and grape dashed nearly the whole dead to the earth. Nicholas was mortally wounded and the intrepid Shaw stood alone. With wonderful coolness he looked at his watch, and saying it was too late to carry the breaches rejoined the masses at the other attack. After this no further effort was made at any point, and the troops remained passive but unflinching beneath the enemy's shot which streamed without intermission; for of the riflemen on the glacis, many leaping into the ditch had joined in the assault, and the rest, raked by a cross-fire of grape from the distant bastions, baffled in their aim by the smoke and flames from the explosions, and too few in number, entirely failed to quell the French musketry.

About midnight when 2,000 brave men had fallen, Wellington who was on a height close to the quarries, ordered the remainder to retire and re-form for a second assault; he had heard the castle was taken, but thinking the enemy would still resist in the town was resolved to assail the breaches again.

This retreat from the ditch was not effected without further carnage and confusion, the French fire never slackened, a cry arose that the enemy was making a sally from the distant flanks, and there was a rush towards the ladders. Then the groans of the wounded, who could not move and expected to be slain, increased, and many officers who had not heard of the order, endeavoured to stop the soldiers from going back; some would even have removed the ladders but were unable to break the crowd.

All this time Picton was lying close to the castle, and either from fear of the loss of a point which ensured the capture of the place, or that the egress was too difficult, made no attempt to drive the enemy away from the breaches. On the other side however the 5th Division had commenced the false attack on the Pardaleras, and on the right of the Guadiana the Portuguese were sharply engaged at the bridge, thus the town was girdled with fire, for Walters' Brigade having passed on during the feint on the Pardaleras, was escalading the distant bastion of San Vincente. His troops had advanced along the banks of the river and reached the French guard-house at the barrier gate undiscovered, the ripple of the waters smothering the sound of their footsteps; but just then the explosion in the breaches took place, the moon shone out, the French sentinels discovering the columns, fired, and the British soldiers springing forward under a sharp musketry began to hew down the wooden barrier at the covered way. The Portuguese panic-stricken, threw down the scaling ladders, the others snatched them up again and forcing the barrier jumped into the ditch; but the guiding Engineer officer was killed, there was a cunette which embarrassed the columns, and the

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ladders proved too short, for the walls were generally above 30 ft. high. The fire of the enemy was deadly, a small mine was sprung beneath the soldiers' feet, beams of wood and live shells were rolled over on their heads, showers of grape from the flank swept the ditch, and man after man dropped dead from the ladders.

Fortunately some of the defenders had been called away to aid in recovering the castle, the ramparts were not entirely manned, and the assailants discovering a corner of the bastion where the scarp was only 20 ft. high, placed three ladders there under an embrasure which had no gun and was only stopped with a gabion. Some men got up with difficulty, for the ladders were still too short, and the first man who gained the top was pushed up by his comrades and drew others after him until many had won the summit ; and though the French shot heavily against them from both flanks and from a house in front, their numbers augmented rapidly and half the 4th Regiment entered the town itself to dislodge the French from the houses, while the others pushed along the ramparts towards the breach and by dint of hard fighting successively won three bastions.

In the last of these combats Walker leaping forward sword in hand at the moment when one of the enemy's cannoneers was discharging a gun, was covered with so many wounds that it was wonderful that he could survive, and some of the soldiers immediately after perceiving a lighted match on the ground cried out that it was a mine ! At that word, such is the power of imagination, those troops who had not been stopped by the barriers, the ditch, the high walls, and the deadly fire of the enemy, staggered back appalled by a chimera of their own raising ; and in this disorder a French reserve under General Veillande drove on them with a firm and rapid charge, pitching some men over the walls, killing others outright, and cleansing the ramparts even to the San Vincente. There, however, Leith had placed Colonel Nugent with a battalion of the 38th as a reserve, and when the French came up shouting and slaying all before them, this battalion, 200 strong, arose and with one close volley destroyed them ; then the panic ceased, the soldiers rallied, and in compact order once more charged along the walls towards the breaches ; but the French, although turned on both flanks and abandoned by fortune did not yet yield. Meanwhile the portion of the 4th Regiment which had entered the town was strangely situated. For the streets were empty and brilliantly illuminated and no person was seen, yet a low burr and whispers were heard around, lattices were now and then gently opened, and from time to time shots were fired from underneath the doors of the houses by the Spaniards, while the troops with bugles sounding advanced towards the great square of the town. In their progress they captured several mules going with ammunition to the breaches ; yet the

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square itself was as empty and silent as the streets. The tumult at the breaches was however like the crashing thunder, and showed plainly that the fight was still raging there, and hence, quitting the square the troops attempted to take the garrison in reverse by attacking the ramparts from the town side, but they were received with a rolling musketry, driven back with loss, and resumed their movement through the streets. At last the breaches were abandoned by the French, other parties entered, desultory combats took place, Viellande and Phillipon, the latter of whom was wounded, seeing that all was lost, passed the bridge with a few hundred soldiers and entered San Christoval, which was surrendered next morning upon a summons to Lord Fitzroy Somerset, for that officer had with great readiness pushed through the town to the drawbridge before the French had time to organize further resistance. But even in the moment of ruin the night before, the noble Governor had sent some horsemen out from the fort to carry the news to Soult, and they reached him in time to prevent a greater misfortune.

Of the excesses committed by the troops, and the violence which resounded for two days and nights in the streets of Badajoz it is unnecessary to write in this article. On the third day, when the city was sacked, when the soldiers were exhausted by their own excesses, the tumult rather subsided than was quelled; the wounded men were then looked to and the dead disposed of. Five thousand men and officers fell in this siege, and of these, including 700 Portuguese, 3,500 had been stricken in the assault, 60 officers and more than 700 men being slain on the spot. The five Generals, Kempt, Harvey, Bowes, Colville, and Picton, were wounded, the first four severely; 600 men and officers fell in the escalade of San Vincente, as many at the castle, and more than 2,000 at the breaches, each division there losing 1,200!

When it is realized that this frightful carnage took place in a space less than a hundred yards square—that the slain died not all suddenly nor by one manner of death—that some perished by steel, some by shot, some by water, that some were crushed and mangled by heavy weights, some trampled upon, some dashed to atoms by the fiery explosions—that for hours this destruction was endured without shrinking and the town was won at last, the invincible courage of the British can be more clearly appreciated. And it is entirely wrong to suppose that the French were unworthy enemies, as the garrison stood and fought manfully and with good discipline. Yet who shall do justice to the bravery of the British soldiers! the noble emulation of the officers! Who shall measure out the glory of Ridge, of Macleod, of Nicholas, of O'Hare of the 95th, who perished on the breach at the head of the stormers, and with him nearly all the volunteers for that desperate service! Who shall describe the martial fury of that desperate rifleman, who, in his resolution to win,

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thrust himself beneath the chained sword-blades and there suffered the enemy to dash his head to pieces with the ends of their muskets! Who can sufficiently honour the intrepidity of Walker, of Shaw, of Canch, or the hardiness of Ferguson of the 43rd, who having in former assaults received two deep wounds was here, his former wounds still open, leading the stormers of his regiment, the third time a volunteer, the third time wounded! No age, no nation ever sent forth braver troops to battle than those who stormed Badajoz, and Lord Wellington's passionate outburst of grief when he heard of the night's havoc was but a fitting tribute for the loss of his gallant soldiers.

(*To be continued*).

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TRANSCRIPT.

THE SIEGE OF ADRIANOPLE.

From an article by V. N. POLYANSKI in the September, 1913, and subsequent numbers of *Injenerni Jurnal*.

(*Continued*).

CHAPTER II.

THE STRENGTH AND EQUIPMENT OF THE ATTACK.

The Siege Armies.

The IInd Bulgarian Army under General Ivanov, and the Bulgarian heavy artillery, were present throughout the siege. After the Battle of Kumanov, in which the Turkish main army in Macedonia was defeated by the Servians under Prince Alexander, the IInd Servian Army consisting of two divisions joined the siege army, and was placed under the supreme command of General Ivanov. Later on, the Servian Siege Park also joined.

Hence *troops of both Allies* operated against Adrianople. The heavier task fell, in the end, to the Bulgarians, but the help afforded by the Servians was so substantial that without it the place could not have been captured, in spite of the unfinished condition in which its defence works were found to be in October, 1912.

The numbers of the besiegers did not remain constant throughout the siege. In the first period (before the armistice), when only a blockade of the fortress was contemplated, the numbers were as follows :—

Infantry (Bulgarians and Servians)	..	80 battalions.
Field guns	250	,,
Heavy guns	102	,,
Cavalry	11	squadrons.

Grand total, 80,000 men.

Subsequently, when it was decided that the fortress must be taken by assault, the armies were reinforced to the following strength :—

Bulgarians	105,000 men, with 342 guns.
Servians	47,000 men, with 98 guns.

Grand total, 160,000 men.

The nature of the troops was also changed, as the regular troops had to be sent away to reinforce the Chatalja Army, and their place was taken by reserves.

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BRIEF DESCRIPTION OF THE BULGARIAN AND SERVIAN TROOPS.

Infantry.

The Bulgarian division consists of three brigades (24 battalions); the brigade consists of two regiments; the regiment of four battalions (*drujina*); and the *drujina* of four companies. The Servian division consists of four regiments (they have no brigade organization); the regiment, of four battalions; the battalion of four companies (*cheti*), and the *cheti* are divided into tenths (sections).

The Bulgarian infantry are armed with the 8-m.m. Mannlicher magazine rifle, and the Servian infantry with the 7-m.m. Mauser. Both have blunt-headed bullets and short sword-bayonets. The number of cartridges carried by the Bulgarians is as follows:—On the soldier, 120; in the battalion two-wheeled transport, 40; and in the park, 90 per rifle. By the Servians:—On the soldier, 150; in the regimental transport, 60; and in the divisional transport, 100 per rifle. A very noticeable feature of the Servian infantry was their extreme economy in the expenditure of ammunition and their good fire discipline, in consequence of which their ammunition supply was found to be fully sufficient.

Both rifles were adapted for firing with or without fixed bayonets. The Bulgarians preferred the former as they anticipated difficulty in fixing bayonets prior to an assault.

The Servian infantry carried hand grenades of the Swedish "Ozen" pattern, slung from the belt. The peculiarity of these grenades was that on bursting they gave off a black smoke, making a smoke screen in addition to other damage. Each company had 46.

Three-quarters of the Bulgarian infantry and one-half of the Servian infantry were equipped with small shovels. Later on, however, all the men in both armies carried them, the numbers being made up from those captured from the Turks in the first battles.

The standard of military training of both armies was high. Many of their regulations and instructions had been drawn up since the Russo-Japanese War, and were quite up to date. In their tactics French views prevailed. In technical training, the Bulgarians followed the Russian school, their engineer instructions were Russian, and also their fieldwork types. They had instructions for the siege of fortresses.

The Servian fieldwork types and the general basis of their field engineering instructions were German, but just before the war some special instructions were prepared by them and issued in the form of lithographic slips.

Field Artillery.

Each Bulgarian infantry division included a field q.f. regiment and a field non-q.f. regiment. The former was divided into three "divisions," each of three 4-gun batteries (36 guns), and the latter of two "divisions" (24 guns).

The Bulgarians had, besides, nine batteries of 12-c.m. field q.f. howitzers, the greater number of which were used against Adrianople.

Each Servian division had one q.f. regiment, consisting of three "divisions," or nine batteries (36 guns). They had before Adrianople two regiments, less one division, total 60 q.f. guns.

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Table showing the characteristics of the field artillery of the Allies :—

Calibre and System.	Extreme Range.		Types of Shell.
	Shrapnel.	Common.	
75-m.m. q.f. Schneider-Creusot gun.	6000	6000	Shrapnel, common, with 6·5 kilogrammes.
8·7-c.m. non-q.f. Krupp gun	4000	6000	Shrapnel, case, common, with powder.
7·5-c.m. non-q.f. Krupp gun	3000	6000	Shrapnel, case, common, with powder.
12-c.m. q.f. field howitzer (Schneider).	6500	6500	Shrapnel, high-explosive, with 20·5 kilogrammes.

The Servian 75-m.m. gun was an excellent weapon, of the latest French pattern. Its advantage over the Bulgarian one was that it had the independent line of sight. The q.f. guns and howitzers were equipped with shields, and the ammunition boxes had armoured bottoms and lids. The batteries carried portable observatories, telephones and signalling apparatus.

The training of the Servian artillery was first-class and their regulations and tactics were identical with those of the French. The training of the Bulgarian artillery was also good, with French views predominating.

The *engineer troops* included pioneer units and corps of military engineers. The pioneers do not normally form a part of the Bulgarian division, but may be allotted to the divisional commander. The Servians have two pioneer companies in a division. At Adrianople the number of pioneer units was very inconsiderable. The details of actual numbers were not obtainable, but apparently there was not more than one battalion, allowing one half-company to each brigade section of the investment line. Engineers.

The commander of engineers of the siege armies was Major-General Vazov, who was subsequently made commandant of the front chosen for attack. His assistants were Colonel Dobrevski, who commanded the engineers on the North-East Front, Lieut.-Colonel Silyanovski (North-West Front), Capt. Matov (South Front), and others. On the West Front there were Servian engineers.

The commander of engineers of the Bulgarian armies was General Yankov, and his assistant was Major Rankov, who had charge of the technical branch. All the engineers in the Bulgarian service who were serving with siege companies before the fortress had qualified at the Nikolaev Engineer Academy at St. Petersburg. From conversations with various senior officers the writer ascertained that the Bulgarians were well pleased with their *technical knowledge* as military engineers, but considered that the *tactical training* of the Russian Academy was not strong.

A composite Bulgarian-Servian cavalry brigade, consisting of the Bulgarian Life Guards and the Servian Timok Cavalry Regiment, was employed against the fortress. In addition to this, a separate Bulgarian cavalry brigade (eight squadrons) was posted at the village Cavalry.

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of Dimotiki, and operated in conjunction with the besiegers. The cavalry were armed with carbines of the same systems as the infantry.

The Troops.

The Bulgarian soldiers in outward appearance resemble Russians, but there is a great psychological difference in their natures. The former are morose, cunning, deceitful and cruel, qualities entirely opposite to those of the Russians. Outwardly their discipline and drill appear to be very weak, but their knowledge of duty and love of country have been satisfactorily developed. They drink in hatred of the Turk with their mothers' milk, and look upon him not as a man but as a Turk.

The Servian soldiers do not outwardly resemble Russians, but their nature is much more similar. They are more Slavonic, and milder, though passionate and impetuous. They are not naturally cruel and can easily live in harmony with the Turks, as the latter can with them. The Servian officers are more cultured and better educated than the Bulgarians, but the latter are more resourceful and resolute in action.

Heavy Artillery.

The Bulgarian heavy artillery consists of three battalions, the "Sofia," "Shumla" and "Widin." The first two were used against Adrianople. Each battalion, which in peace time consisted of two companies, each of 80 men, was raised on mobilization to 3,000 men, and was divided into "heavy" and "light" divisions, which in turn were split up into groups, with two to three batteries to a group. The batteries were 4-gun, 3-gun, 2-gun and even single-gun. The total number of guns in the Sofia and Shumla Battalions was 102.

The following table shows the characteristics of the Bulgarian siege artillery (guns of the same calibre which differed in length of bore are described conventionally by the letter L over the number of calibres in the length of the bore) :—

Calibre and System.	Range in Metres.		Types of Shell.
	Shrapnel.	Common.	
Schneider-Creusot.			
(1). 12-c.m. L/25 lightened gun.	6000	7510	Shrapnel, common, with 16 kilogrammes powder.
(2). 12-c.m. L/28 lightened gun.	6500	7850	Shrapnel, common, with 20 kilogrammes powder.
(3). 15-c.m. howitzer	—	5180	Shrapnel, high-explosive, with 40 kilogrammes.
Krupp.			
(4). 12-c.m. L/30 long gun ..	7825	9650	Shrapnel, common, with 20 kilogrammes powder.
(5). 15-c.m. L/30 long gun ..	9660	10420	Shrapnel, common, with 40 kilogrammes powder.
(6). 12-c.m. non-q.f. howitzer	—	5470	Shrapnel, high-explosive, with 20 kilogrammes.

The platforms for the heavy guns were of French pattern, consisting of three cross-ledgers, with long bolts, on which were laid four layers of planking ("shields"), with holes for the bolts to pass through, the whole being secured with nuts. Two of the 15-c.m. had, instead of platforms, *wheelways, i.e.*, wide "runs" held together by distance pieces.

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They had special shoes for the trails and wedges for the wheels. These were very serviceable platforms and gave the guns great mobility.

The Servian Siege Park, which arrived after the armistice, consisted of the following Schneider-Creusot weapons of new construction :—

12-c.m. long guns	10
12-c.m. q.f. howitzers	20
15-c.m. q.f. howitzers	8

The last-named were the most powerful and the best weapons in the siege park of the Allies.

As the supply of warlike stores was maintained with difficulty, an extreme but prudent economy was observed in the expenditure of ammunition.

Subsidiary Equipment of the Attack.

For aerial reconnaissance the Bulgarians had two captive balloons and 25 aeroplanes, but from the weakness of the *personnel* and the want of repair of the *matériel* only one balloon and six aeroplanes were used.

In November the Russian detachment under M. Shchetinin (First Russian Aeroplane Company) arrived with four aeroplanes of the Farman No. 7 type, and some *personnel*. The aeroplane park was at Mustapha-Pasha.

The balloon, used for regulating the fire of the heavy batteries, proved of the very greatest service. The aeroplanes flew over the fortress, threw out proclamations, and produced some moral effect, but were of no actual use, as they flew at a height of not less than 4,000 to 5,000 ft., and consequently could obtain no information of any value. The general construction of the fortress was already known, and details of the construction and the posting of the troops could not be seen from so great a height.

Heavy fire was brought against the aeroplanes from rifles, 10·5-c.m. guns and from guns of special design, but during the whole period of the siege only once was the observer in the captive balloon wounded by shrapnel. The Bulgarian airman, Tarokchiev, was killed in a fall of his aeroplane at Mustapha-Pasha.

The Bulgarians had six *searchlights* with 60 and 90-c.m. projectors ; they were allotted to the heavy artillery, and worked satisfactorily and usefully. One searchlight was disabled by a Turkish shell.

Communication.

Communication throughout the besieging forces was maintained by telegraph and telephone. Great importance was attached to the organization of communications, and yet this was not always a success, as will be seen in the survey of the military operations.

Besides the telephones with the troops, the divisions had telegraph detachments, and in addition there were 200 kilometres of cable in the Engineer Park. But this quantity proved insufficient, and during the siege the Bulgarians obtained 600 kilometres more.

So large a requirement of telephone cable is explained by the *necessity to have a double network laid in all directions*, owing to the frequent instances of damage being done to the cable by their own troops.

During attacks they sent forward telephone stations with the advanced troops in the endeavour to connect up captured points immediately with the rear. For this purpose in addition to the troops' telephone

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systems, they laid out systems from the divisional headquarters, *duplicating* the troops' systems, and making terminals from which to lay out further developments.

The artillery had their own systems, independently of the infantry.

In the Engineer Park, besides large entrenching tools and other technical equipment, the Bulgarians had 1,000 *body shields* of French pattern, for protecting sappers from rifle bullets when demolishing obstacles. These shields were of 6-m.m. steel and were fitted with felt slings for carrying slung from the neck, and with loopholes for firing through. They weighed about 9 lbs. each. It was found that at a distance of 50 paces the sharp-nosed bullet went right through them, and as the wire obstacles were usually placed at this distance from the enemy's trenches, they did not prove of much assistance.

Lieut.-Colonel Silyanovski proposed a shield made of two of these shields with a 10-m.m. air space between them, but it was rather heavy.

Before the war, the Bulgarians had discussed a shield of 12-m.m. steel of German make, but it weighed about 44 lbs., and was not adopted.

For wire cutting there were special cutters, with which both the pioneers and the infantry were equipped, and also explosives.

Transport.

Transport Equipment.—For the carriage of stores to the besieging armies the Bulgarians used the normal gauge Sofia-Constantinople railway, as far as the station at Mustapha-Pasha. From there the loads were dragged by bulls and buffaloes, the carts being attended by the owners of the beasts, among whom were many Turks who were Bulgarian subjects. By this arrangement—that the carts were attended by the owners of the draft animals—the latter were well cared for and did very useful work. In spite of this, in the transport of stores and guns fully 2,000 head died. This form of transport was the only possible one, on account of the very bad condition of the roads in European Turkey.

Each heavy gun under normal conditions was dragged by four pairs of bullocks, but during rainy weather the teams were doubled. In this manner the field artillery also was dragged through the mud, as the horses sank in and were unable to pull the guns. The rapidity of transport with bullocks was from 1 to 1¼ miles per hour.

The Bulgarians had no portable railway, and motor lorries were brought up only towards the end of the campaign.

CHAPTER III.

MEASURES PREPARATORY TO THE MILITARY OPERATIONS.

FOR a long period previous to the war the Bulgarian general staff, recognizing that it was inevitable, and fully appreciating the strategic importance of Adrianople, had been systematically preparing for the eventual siege of that fortress.

The preparations for the siege had been careful and thorough, and had been carried on in conjunction with the general preparations for military operations in Thrace. For the last 15 years they had been under the supreme direction of Major-General Fichev, a capable and widely experienced man, who devoted himself entirely to this duty.

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He had received his higher education in the Italian Military Academy, and in the war held the post of Chief of the Staff of the Army.

The fortress had been studied by the actual reconnaissance of Bulgarian officers, and also by means of a system of agents, on whom the Bulgarians had expended as much as from 50,000 to 60,000 francs annually.

The map had been prepared progressively. It was begun upon the foundation of the Russian 3-*verst* map, and all information and corrections, as they were received, were added to it. The surrounding country was reconnoitred, and sites for the strong points were marked upon the probable positions of the attack. On the 1st July, 1911, a fair copy was prepared in which all the data which had been obtained up to that date were shown, including all the defence works of the fortress. The scale was $\frac{1}{20000}$ with contours at 5-metre vertical intervals, and chain-dotted contours at 40-metre vertical intervals.

In that year the Bulgarian Staff carried out a fortress war-game, with the object of bringing into prominence the strong and weak points of the fortress, and of preparing a plan of attack.

Notwithstanding the minuteness of the information which had been obtained, it did not prove to be completely accurate. It appears to have exaggerated the strength of the forts, by assuming that those of the North-West Sector were fully completed specimens of the German designs, which they certainly were not. The wire entanglements, which surrounded the fort line in a continuous ring, were not shown. The Bulgarians did not credit the information which had been supplied by their agents in this case. To them the distribution of the entanglements appeared to be absurd, but it was in fact correct. A Turkish engineer explained this distribution by saying that the lines of obstacles had been laid out by the soldiers themselves, in his absence. No works were shown on the map which had been constructed subsequently to the 1st July, 1911, and naturally all the works which were carried out during the period of mobilization were wanting.

Field Operations in the Fortress Area.

The mobilization of the Bulgarian troops was ordered on the 29th September, 1912, and it was carried out harmoniously and expeditiously. Three armies were formed for the operations in Thrace:—Ist Army, General Kutinchev; IInd Army, General Ivanov; and IIIrd Army, General Radko Dmitriev. At the head of all the armies there stood nominally Tsar Ferdinand, and actually his assistant, General Savov.

On the 17th October they commenced their advance, the general objectives of the three armies being laid down as follows:—The Ist Army, on the centre of the Turkish position, which extended from Adrianople to Kirk-Kilisse; the IInd Army, on the Turkish left flank, the fortress of Adrianople; and the IIIrd on their right at Kirk-Kilisse.

Kirk-Kilisse, or Lozengrad, was, in the words of Goltz-Pasha, "so strong that only a Prussian army could capture it, and that only after a three-months' siege." It lay 38 miles to the east of Adrianople, in the same vilayet, at a junction of metalled and unmetalled roads. It had been fortified to form the right flank of the Turkish defensive line,

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and, shortly before the war, a branch line of railway had been laid to it from the station of Lupulu on the Sofia-Constantinople railway.

It is impossible to call Kirk-Kilisse a fortress, as it was neither defended by all-round fortifications, nor did the local conditions render it secure from envelopment, and consequently it was not proof against assault.

Its permanent defences consisted of only two forts—lunette batteries—of the seventies. These lay on the north side of the town at a distance from the latter of from 1 to 1½ miles, and from 2 to 2½ miles apart. They could see one another, but the low ground between them was not swept by their fire. In their front there was from one-half to three-quarters of a mile of ground which was dead from the forts, but commanded by rifle trenches placed in front of them. The Bulgarians named the left fort "Ferdinand" and the right "Bulgaria."

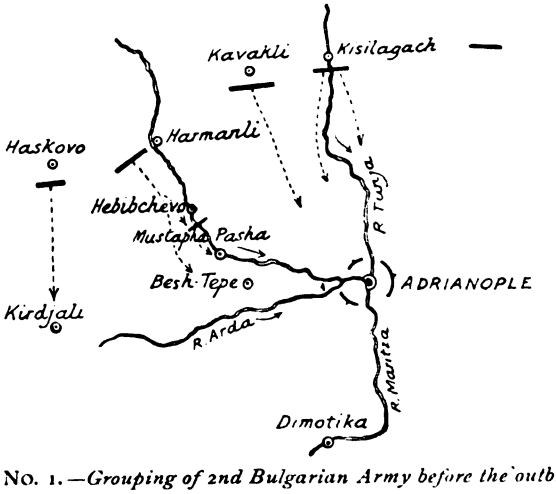
In addition to the forts there were a few field batteries and rifle trenches to the west and east of the town. The lines generally commanded the ground within 35 to 45 yards of their front, but they were themselves commanded from high ground lying 3¾ to 4½ miles to the north.

Why Goltz-Pasha should have spoken in such flattering terms of a "fortress" consisting only of two old forts, is quite unintelligible. In all probability his object was to deceive the Bulgarians.

It will now be understood why *the main attack of the Bulgarian forces was directed against the right flank of the Turkish line*, and how it came about that the first collision of the opposing forces received the name among the Bulgarians of the Battle of Lozengrad. It may be mentioned that in an old plan of operations, which was known to the Turks, it was proposed that the Bulgarians should turn the Turkish left flank at Dimotica.

With a view to acting against Adrianople the units of the IInd Army were concentrated in readiness as follows (see sketch plan) :—

1st Brigade, 2nd Infantry Division, at Haskovo.
8th Infantry Division at Harmanli.
9th Infantry Division at Kavakli.
3rd Infantry Division at Kisilagach.



PLAN NO. 1.—*Grouping of 2nd Bulgarian Army before the outbreak of war.*

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On the east of the 3rd Division, for connection with the Ist Army, there were moved up six cavalry regiments ; in front of the 8th Division, on the Bulgarian-Turkish frontier, at Hebibchevo, there were six squadrons. These squadrons were to be the first to cross the frontier, with the object of seizing the stone bridge across the Maritza at Mustapha-Pasha, one of great importance to the Bulgarians, as if the bridge had been destroyed they would have had great difficulty in bringing up supplies for the use of the troops operating against Adrianople.

These cavalry carried out their task successfully. The regiment of Turkish infantry, with one battery, after slight resistance evacuated the town of Mustapha-Pasha, and on their retirement made an attempt to demolish the bridge. But in this they were prevented by the energetic action of the cavalry, and only succeeded in doing slight injury to one of the piers.

The advance of the columns of the IInd Army was begun on the same day, their marches being calculated with the following objects :—(1) To attract a strong garrison to the fortress, to draw away the Turkish reserves towards the left flank, and thereby to support the attack of the Ist and IIIrd Armies ; (2) in case of the success of the field operations, gradually to proceed with the investment of the fortress, and to make it impossible for the garrison to operate against the communications of the Ist and IIIrd Armies.

It appears that an assault on the fortress did not enter into the plans of the Bulgarian Headquarters.

For the fulfilment of these objects the movements of the columns of the IInd Army were so directed as to threaten the fortress from the north and north-west ; to surround it completely was beyond the strength of this army. The 1st Brigade, 2nd Division, was directed to move from Haskovo on Kirdjali, where Turkish troops had been located. The 8th Infantry Division advanced along the right bank of the Maritza, from Harmanli on Mustapha-Pasha and Besh-Tepe. The staff of the IInd Army went with this division and halted at Mustapha-Pasha.

The 9th Infantry Division advanced from Kavakli, across the Sakar-Planina Range, between the Maritza and Tunja, upon Adrianople. The 3rd Infantry Division advanced in the same direction along the Tunja, having one brigade on the right, and two on the left, bank.

The last-named column was intended to keep in touch with the Ist Army, and, for communication with the 8th Division, the cavalry which had captured the bridge at Mustapha-Pasha was allotted to its right brigade. Nevertheless the connection between the columns was weak. The 8th and 9th Divisions lost touch from the beginning of the forward movement, and only re-established it two days later before Adrianople. According to the staff of the 9th Division this was caused by the difficult conditions under which the division had to move over the Sakar-Planina Mountains.

On the 17th and 18th October the columns of the IInd Army moved on uninterruptedly, without encountering any opposition ; on the 19th the advanced guard of the 9th Division dislodged, after some fighting, some small Turkish detachments on the north of the fortress, and approached the fortress positions ; the 8th Division completed the

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turning movement and approached the fortress from the west side. On the 21st fighting commenced along the whole line from Adrianople to Kirk-Kilisse, and on the 22nd the 8th Division after a series of fights dislodged the Turks from the villages Chermen, Besh-Tepe and Yurush.

On these same days the Ist Army routed, in an encounter battle at the village Seliola, the centre of the Turkish Army, and the IIIrd Army advanced on Kirk-Kilisse. The Turks met the Bulgarians on some strong mountain positions considerably to the north of this place, and fought with resolution, but the turning of their flank and the unexpected appearance of a Bulgarian brigade in rear of Lozengrad on the night of the 22nd—23rd, spread panic among the Turkish troops, and they fled, evacuating Kirk-Kilisse without fighting. The defeat of the Turks appeared to be the result of a preconceived idea that the Bulgarians intended to turn their left flank. In order to throw back their enemy to the west they advanced their right flank, and thereby favoured the Bulgarian turning movement. This premature advance of the Turks—commenced before they had concentrated their forces, and in spite of the plan of operations which had been arranged—inevitably led to disaster.

On the 21st the garrison of the fortress made a sortie with weak forces in an easterly direction, but were thrown back with heavy loss.

On the 23rd all the Turkish armies were in full retreat on the Lule-Burgos position, leaving Adrianople to its fate.

During this period the fortress performed the valuable services of attracting to itself three out of the nine divisions of the Bulgarian Field Army, and of securely protecting the left flank of the Turkish armies. This made it possible for the Turks, without fears for their left flank, to move their reserves to Lozengrad with the intention of attacking the left flank of the IIIrd Bulgarian Army. But these general reserves approached the field of battle only to find that all was over, and the Turkish Army already beaten.

This was the whole share of the fortress in the Battle of Lozengrad. It is true that the Turks attempted a sortie in an easterly direction, but with such small forces that it could in no way have influenced the operations of the Ist Army.

If the number of the garrison be taken into consideration—almost equal to, if not exceeding, that of the IInd Army—there would be reason to have expected active operations by the Turks in large numbers against the flank of the Ist Army. The conditions were very favourable for them, as the IInd Army had advanced against the North-West and West Sectors of the fortress, which were the most strongly fortified. For the defence of these positions the Turks might have detailed a quite insignificant force, and could have directed the greater part of the garrison without any risk against the flank of the Ist Army. In case of failure they could easily have retired upon the fortress, while success would have completely reversed the results of the action, for the fortress would then have threatened the rear of the victorious IIIrd Army, and might have held it back pending the arrival of the strategic reserve.

The action of the Bulgarians was correct. They were bound to advance in the directions chosen, as it would have been too risky to

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have attempted to turn the fortress from both sides in the presence of so strong a garrison. To divert larger forces with the object of attempting to take the fortress by assault would have been unsound, as their main object—to defeat the enemy's field army—required that the decisive blow should be struck against the other flank. Furthermore an assault on the fortress could hardly have succeeded without the help of heavy artillery.

It must also be remembered that the two brigades of the 3rd Division which moved against the fortress from the north on the left bank of the Tunja were in communication with the Ist Army, so that in case of a powerful sortie towards the east, they might have parried the blow. It is probable, indeed, that the destruction of the sortie of the 21st October was actually carried out by these brigades.

The fighting of the portions of the IInd Army on the north and west, though it was not very serious, nevertheless achieved its object, in chaining the garrison to the fortress positions.

(*To be continued*).

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REVIEWS.

ALLEN'S COMMERCIAL ORGANIC ANALYSIS (VOL. III. HYDROCARBONS, PETROLEUM, AROMATIC ACIDS, EXPLOSIVES).

By DAVIS & SADTLER.—(Published by J. & A. Churchill).

IN these days when the road engineer and mechanical engineer are increasingly using hydrocarbons in their various forms both to improve the surface of the roads and to drive and lubricate the motor engines which give power to our machines which run on the earth, which fly in the air, and which penetrate under the sea, it is well that the constituents of these should be thoroughly understood.

Messrs. Davis & Sadtler have produced a volume dealing with these matters, and in the latest edition have brought up to date the information as to their special qualities, with methods of detecting and estimating their impurities and adulterations.

It is a book which should be found in every engineering library, and for all who are interested in the employment of oils and the large family of benzines and petroleum products it will prove a mine of valuable information.

A useful chapter on explosives by A. Marshall, the Chief Chemical Examiner of the Indian Ordnance Department, has a special interest for the military engineer.

The price of the book is 21s. net and containing as it does 600 pages of scientific research, it will be conceded that it is well worth the money.

The work is produced by the publishers in their usual excellent style.

J.W.

RECOLLECTIONS WITH REFLECTIONS.

By MAJOR-GENERAL SIR THOMAS FRASER, K.C.B., C.M.G., R.E.—(William Blackwood & Sons, Edinburgh and London. 15s. net. With Portrait and Maps).

THE author gives a *précis* of the Military Services of his family while in Ireland from the 17th century, and of the events of his own life up to the San Stephano Treaty in 1878. It was the writer's good fortune to be an eye-witness of the great military events of the period and get a valuable narrative of his experiences in France in 1871, and in Paris during the Commune, while recent history gives special piquancy to his Turkish records of the time, and to the part he took in both European and Asian Turkey in 1876, and in the Russo-Turkish Campaign of 1877 in Bulgaria, where he was present on secret service.

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NOTICE OF MAGAZINE.

REVUE MILITAIRE SUISSE.

May, 1914.

THE BATTLE OF SEMPACH.

By Capt. B. de Cerenville.—The writer claims for this battle the most important place in Swiss annals, and considers that its anniversary might well be made a national holiday. The article is of historical interest only.

DIVISIONAL STAFF DUTIES.

By Colonel E. Louderegger.—The writer expresses doubts as to whether the present system of issuing orders quite conduces to the sure and rapid movement of the new Swiss Division, which consists of three brigades instead of two. Including the Chief Staff Officer there are now four staff officers with the division. The compilation of orders for the train is frequently the cause of delay in the issue of the combined orders. When once the General and his C.S.O. have made up their minds what course to pursue, there should be no reason why the staff officer entrusted with the administration of duties in rear should not compile his orders whilst the remainder are compiling the tactical orders. All could then be issued together, but it would save further time if the two classes of orders were issued on separate papers, so that they could be read simultaneously by the various officers concerned in the brigades and other units.

The issue of combined orders simultaneously for all units is laid down in the regulations as a general rule, but separate orders may be issued when the case demands, and greater use might be made of this proviso. Several cases are taken from the 1912 manœuvres where this course might have been pursued with saving of labour to the Divisional Staff, and much greater convenience and saving of time to the troops concerned. Such orders can frequently be compiled simultaneously by different staff officers. Each order should contain information on the situation, the general positions of neighbouring troops, and of the intentions and position of the Divisional General, but details only applicable to other bodies of troops need not be included. In schools and courses for staff officers the distribution of work amongst subordinates and the issue of separate orders should be frequently practised, and this should be supplemented by exercises and war games for each staff as a whole independently of manœuvres.

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REGULATIONS FOR VISUAL SIGNALLING.

By L.—A short account of the steps leading up to the issue of these regulations for all arms, with a summary of the principal points. The regulations are not peremptory ; cavalry and artillery may use them or not as they like, infantry may use their old flags and lanterns, or employ screens and special lanterns, so long as they make the signals in accordance with the prescribed principles, *i.e.*, the Morse alphabet, conventional signs, and code of abbreviations. With luminous apparatus a dot is represented by a flash, a dash by a longer flash, with flags, discs or screens a dot is signalled by showing one, a dash by showing two.

VOLUNTARY TRAINING.

A contribution towards Major Verrey's suggestion that young officers should do more, outside their actual periods of training, to fit themselves for their military duties. The writer considers that the will to do so is not lacking ; what is required is stimulus and encouragement from the nation at large, their representatives, and the military authorities. Victory does not always fall to the side of big battalions and large resources ; moral courage and a determination to win are of great importance. In some countries, notably in Japan and Germany, the whole nation is trained to think of war not as an abstract possibility, but as a reality that may take shape at any moment. From childhood patriotism is inculcated, books are published setting forth the great events of the Nation's history, with the sole view of moulding a national spirit, engravings and pictures of glorious episodes in war are to be seen in libraries and museums, anniversaries of victories are kept as national festivals, Navy and Army Leagues keep these questions constantly before the minds of the people by pamphlets, travelling exhibitions, and lectures, illustrated by the magic lantern, followed by national songs. It is the Nation's work to produce the soldier, the officer's to train him to ideas of courage and self-sacrifice, not only to make him a good marcher, a marksman, and a scout, but to develop his character and martial ardour. In a militia or territorial army it is especially difficult to obtain these results.

It is all very well to suggest that an officer should train himself of his own free will, should collect parties of his men, and take them out on Sundays for exercises and instruction, but where is he to obtain arms, uniform, tools and other materials ? The Council of War will not authorize their issue, pleading lack of funds ; and even if parties were thus trained they would get no benefit from it when they came up for the usual period of training. The re-engagement of N.C.O.'s is discouraged and there is little incentive for efficiency. To remedy these difficulties unit commanders might be given an annual subsidy. If the people and their representatives could only be persuaded of the truth of von Moltke's maxim that " the value of an army depends above all on its patriotism," they would not grudge the money required to develop this virtue.

A.R.R.

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CORRESPONDENCE.

DESTRUCTION OF OBSTACLES.

SIR,

The subject of the destruction of obstacles by means of explosives has received a great deal of attention by many officers commanding units since Major McClintock's article on the Bangalore Torpedo appeared.

The accompanying plate illustrates a torpedo made at Chatham, which is suited to the employment of guncotton slabs.

It has the merits of being simple to make and easy to load. It is easy to place and is more rigid than the cylindrical torpedo.

The only special precautions to be taken are that the tin sheets overlap from the *nose* towards the handle so that the joints do not catch in the entanglement, and that all guncotton dust and fluff after loading is brushed away before finally fixing the top.

I am,

Yours faithfully,

R. N. HARVEY, *Lieut.-Colonel,*
Chief Instructor in Fortification.

Fortification School, 4th June, 1914.

The Editor, *R.E. Journal.*

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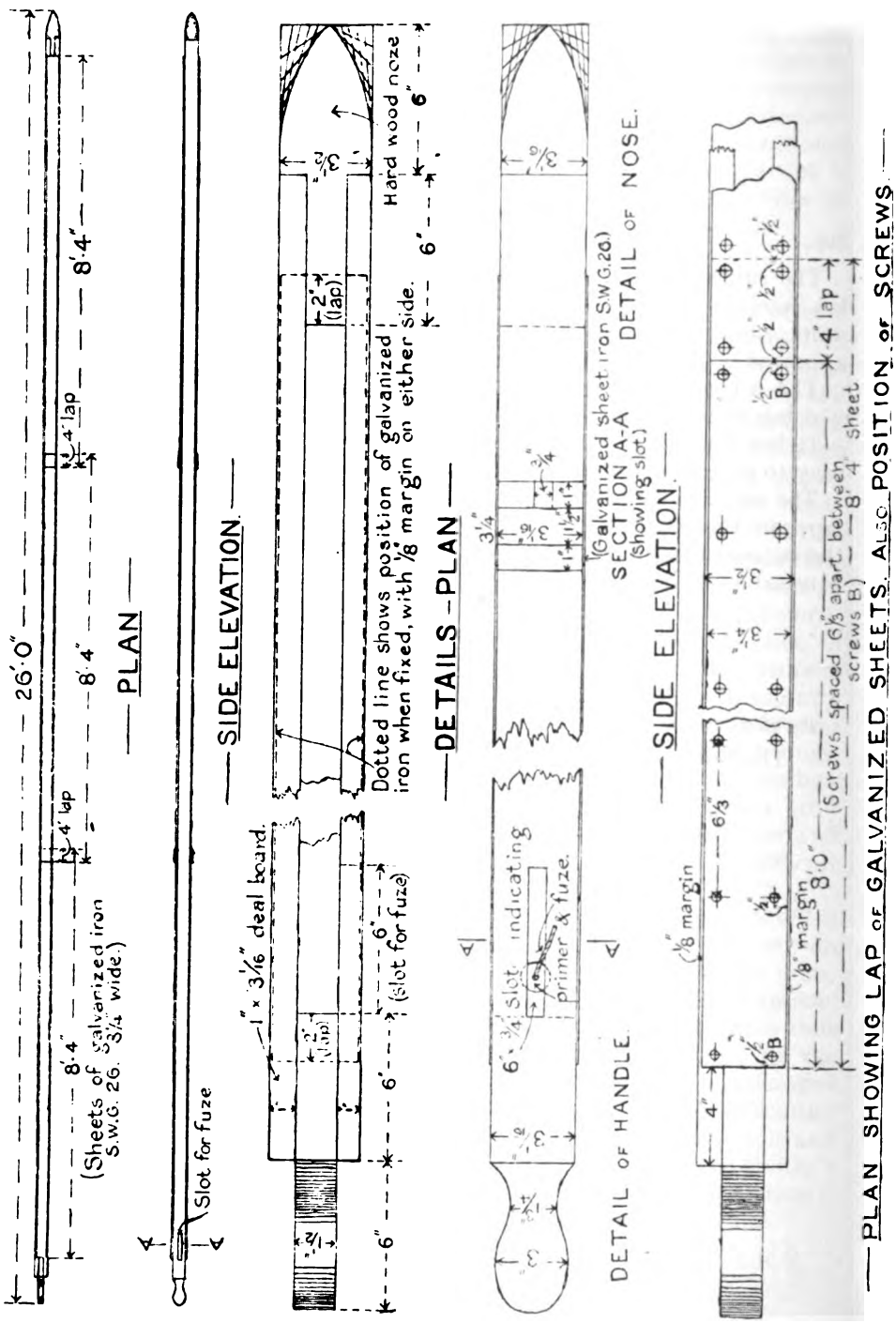
PLAN OF TORPEDO FOR WIRE ENTANGLEMENTS.



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THE MEDALS OF SUBADAR-MAJOR GANGA SINGH, SARDAR BAHADUR, I.O.M., BENGAL SAPPERS AND MINERS.
Order of British India (1st Class.)
Indian Order of Merit (3rd Class.)
NEPAUL 1816-17.
ARRACAN 1824-25
GHAZNI. 23-7-1839
FIRST AFGHAN WAR. 1839-42
JALALABAD. 13-11-1841 7-4-1842.
MAHARAJPORE. 29-12-1843.
First Sikh War (Moodkee Medal) 1845-46.
Second Sikh War (Punjab Medal) 1848-49.

WAR MEDALS OF THE BENGAL SAPPERS & MINERS.

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SOME WAR MEDALS OF THE BENGAL SAPPERS & MINERS.

By LIEUT. P. C. S. HOBART, R.E., *Adjutant, 1st (K.G.O.) Sappers & Miners.*

WITH reference to the series of articles lately contributed to the *R.E. Journal* by Major Biddulph, R.E., the sets of medals here illustrated may be of interest.

These sets belonged to Indian officers of the Bengal Sappers & Miners and came into the possession of the Corps after the deaths of their recipients. They are now in the R.E. Mess, Roorkee, where they were placed by the Commandant, 1st (K.G.O.) Sappers & Miners. The careers of these Indian officers were of so varied a character and embraced so much of the fighting that took place in India in the last century, that a few notes on their services may not be out of place.

SUBADAR-MAJOR GANGA SINGH, SIRDAR BAHADUR, I.O.M., BENGAL SAPPERS & MINERS.

Enlisted in 1816, and received the H.E.I. Company medal for service in the Nepal War. In 1817 he was engaged at the Capture of Hathras, and served throughout the Pindari-Mahratta Campaign of 1817-18.

In 1824 he formed one of the detachment which served with Brig.-General J. W. Morrison's Column in the first Burmese War. This force was based on Chittagong and reached Arrakan after a very arduous march of three months through the jungles. The fortress itself was captured in three days with a loss on our side of only 243, but fever played such havoc during the following hot weather that the remnants of the column had to be withdrawn at the end of 1825. Ganga Singh had been promoted Naik during the campaign and for the next twelve years he was employed with his company on much varied work, including the building of Aligarh Fort, the Jumna Canal, and at headquarters at Delhi.

Towards the end of 1838 the corps was ordered up to Ferozepur to join the Army of the Indus. From here two companies (the 2nd and 3rd), in one of which Ganga Singh was serving, pushed forward under Capt. George Thomson, Bengal Engineers, and constructed the famous bridge that enabled the army to cross the Indus at Rohri Bukkur. No special stores were available and no materials

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had been collected. Ropes and cables were made from grass procured from a spot about 100 miles distant; trees growing locally had to be cut for timber, and even then little except palm was available. Boats were collected with great difficulty. The river at the point chosen for the bridge ran in two channels 400 ft. and 1,100 ft. wide respectively, and the current was very strong. All nails, etc., had to be made on the spot, and each boat anchored by a crib of logs loaded with stones. In spite of all this the bridge was actually completed in 15 days, and five of these were wasted owing to the lack of boats, of which 74 were required in the completed bridge. This achievement was the subject of a special order by the Commander-in-Chief.

From the Indus the army, accompanied by the Sappers, advanced *viâ* the Bolan Pass and Quetta on Kandahar, where Shah Shuja was formally installed on the *masnad*.

The part played by Thomson, and the influence of his ability and energetic personality on the decision to continue the advance to Ghazni, even at the cost of putting the force on short rations and leaving the heavy guns behind, is not as well known as it deserves to be.

The army suffered considerably on the month's march from Kandahar from want of water and food, and on arrival at Ghazni, the fortifications, contrary to all expectations, were found to be in excellent condition and strongly garrisoned. The force was in a critical position. The siege train had been left at Kandahar in order to make the advance possible. Rations were almost exhausted; and there was no possibility of living on the country.

After a careful reconnaissance, undertaken under fire, George Thomson proposed the somewhat desperate remedy of blowing in the Kabul Gate. The result may be told in the quaint words of Sir John Keane's despatch of 24. 7. 1839:—"I have the honour to acquaint your Lordship that the Army under my command have succeeded in performing one of the most Brilliant Acts it has ever been my lot to witness during my service of 45 years in the Four Quarters of the Globe, in the Capture by Storm, of the strong and important Fortress and Citadel of Ghuznee yesterday. It is not only that the Afghan nation, and I understand Asia generally, have looked upon it as Impregnable, but it is in reality a Place of Great Strength, both by Nature and Art . . . I was surprised to find a High Rampart in good repair . . . garrison 3,500 Afghan Soldiers . . . Instead of the tedious process of Breaching (for which we were ill prepared) Capt. Thomson undertook, with the assistance of Capt. Peet, of the Bombay Engineers, Lieuts. Durand and McLeod, of the Bengal Engineers, and other officers under him, to Blow In the Cabool Gate (the weakest point) with Gunpowder, and so much Faith did I place in the Success of

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the Operation, that my Plans for the Assault were immediately laid down, and the Orders given.

The different troops . . . moved off at 12 o'clock that night without the slightest noise and . . . took up position about 250 yards from the walls . . . A few minutes before 3 o'clock in the morning, the Explosion took place and proved Completely Successful . . . On hearing the Advance sounded by the Bugles (being the signal for the gate having been blown in) the artillery opened a terrific Fire upon the Citadel and Ramparts of the Fort, and in a certain degree paralyzed the Enemy.

Under the guidance of Capt. Thomson, of the Bengal Engineers, . . . the Advance proceeded to the Gate, and with Great Difficulty, from the rubbish thrown down and the determined opposition offered by the Enemy, effected an Entrance and established themselves within the Gateway . . .

To Capt. Thomson, of the Bengal Engineers, the chief of the Department with me, much of the credit of this Brilliant *Coup de main* is due; a place of Such Strength and by Such Simple Means as this highly talented and Scientific Officer recommended to be tried, has perhaps never before been taken; and I feel I cannot do sufficient justice to Capt. Thomson's merits, for his conduct throughout. In the Execution he was ably supported by the Officers already mentioned, and so eager were the other officers of the Engineers of both Presidencies, for the honour of carrying the Powder-bags, that the point could only be decided by seniority, which shows the fine feeling by which they are animated . . ."

Our casualties amounted to less than 200, of whom 8 were Sappers (6 Bengal, 2 Bombay). The Governor-General awarded the Order of Merit, 3rd Class, for gallantry to 19 survivors of the explosion party (13 Bengal S. & M., 6 Bombay S. & M.).

Shortly after this exploit Ganga Singh, now a Havaldar, was transferred with 46 other Indian officers and N.C.O.'s to Broadfoot's newly-raised Corps of Sappers, and was granted a commission. And with this famous but short-lived corps he saw all that service in Afghanistan in which they fought their way to renown. They were in action almost daily for the next two years and formed an important part of the " Illustrious Garrison " of Jelalabad, which held out so gallantly from December, 1841—till 7th April, 1842, when they finally fought their own way out. Not only had these gallant men to contend with the fury of the enemy who were in great force, and with the severity of the season, but the walls were hardly put in good order when a violent shock of earthquake once more reduced them to ruins. They were, with the greatest difficulty, successfully repaired, and withstood every attack till the end.

George Broadfoot was the life and soul of the garrison and

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adequate appreciation of his services and difficulties can only be acquired by reading the story of his career.

Ganga Singh was promoted Subadar during the siege and for gallantry he received the Order of Merit (3rd Class). Later he was present at Mamu Khel, Istalif, Khurd Kabul, Tezeen, Gandamak and many other actions. At the conclusion of the war, he was—with the great part of Broadfoot's Sappers—re-transferred to the Bengal Sappers & Miners.

Inside of two years Ganga Singh had thus risen on active service from Naik to Subadar, and had been awarded the Order of Merit. After the Afghan War he again saw service almost at once, as his company in 1843 was ordered on the Gwalior Campaign, and he was present at the Battle of Maharajpur, of which the C.-in-C. wrote that "the advance was only made practicable by the unremitting labour of the Sappers."

Ganga Singh was decorated with the Order of British India (2nd Class) in 1845.

In the autumn of this year the whole Corps was ordered to join the Army of the Sutlej for the First Sikh War. But Ganga Singh was not with his unit, as he had been asked for by his old commanding officer, Major George Broadfoot, now Agent to the Governor-General for the North-West Frontier, and it was in personal attendance on him that he was present at the Battle of Moodkee. He was also present in action at Ferozeshahr and Sobraon. Two years later the Corps was once more out against the Sikhs. The campaign opened with the Siege of Mooltan, where Ganga Singh and his company were present. The Sappers took a leading part, were thanked in despatches for "their zealous, scientific and persevering exertions": specially mentioned "for gallant service": and particularly referred to in Lord Gough's final despatch. One 2nd Class and seven 3rd Class Orders of Merit were awarded to various ranks of the Corps for gallantry in action during the siege. Ganga Singh with his company was also present at the final action of the war—Goojerat on the 21st February, 1849, and this proved to be his last taste of active service. He was promoted to the 1st Class of the Order of British India and became Subadar-Major of the Corps in 1850. Early in 1857 he retired, with over 40 years' service, three decorations, eight war medals and four clasps.

2. Subadar-Major Hanuman Singh, I.O.M., Bengal Sappers & Miners.

Enlisted in 1824, and a year later was marching to Bhurtpore. It was here that the newly reorganized corps, now officered for the first time on active service solely by Engineer officers, really commenced to acquire its reputation. Bhurtpore was proverbial throughout India as an impregnable fortress. Twenty years previ-

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ously the British had attacked it and been repulsed with a loss of 3,000 killed and wounded. A second failure would be a very serious blow to British prestige, whereas complete success would do more than any other single action to enhance the reputation of our arms. The conduct of the regular siege which was now undertaken, devolved largely on the Engineers and Sappers. More especially as the fire of the guns was found not to produce sufficient effect on the fortifications to form a practicable breach, and recourse had to be made to mining. By this means two practicable breaches had been made by 18th January—the 39th day of the siege—but not without heavy losses to the Corps. The task of crossing the ditch, evading the enemy's countermines, and lodging charges of 1,200 lbs. of powder in galleries driven in the far rampart, being one of the greatest danger. During this process Hanuman Singh, whilst working in the advanced sap, was wounded in the head.

The Order of Merit had not yet been instituted, but an Indian officer, a British N.C.O., and several N.C.O.'s and men of the Corps, were promoted in the field by the G.O.C. for "having particularly distinguished themselves by Acts of Enterprize and Gallant Conduct": and for gallantry in "Springing Mines under circumstances of Peculiar Difficulty and Imminent Personal Peril."

The assault, delivered on 18th January, 1826, was completely successful at a cost of about 580 casualties. The Corps received the highest praise for their conduct and training both in G.O.C.C. and in Governor-General's Orders. In an article by "An Eye-Witness" which appeared in the *E.I.U.S. Journal* for 1834 the following occurs: "The behaviour of these men throughout the whole of the operations excited the admiration of the Army. To see them exposing themselves under a hot fire with the most perfect coolness and indifference might have almost made one suppose that they bore charmed lives . . . Indeed, a more efficient body than the Bengal Sappers & Miners have proved themselves, it would be impossible to conceive."

The next fighting Hanuman Singh was to see was the First Afghan War. He was with the two companies that constructed the great Rohri Bukhur Bridge over the Indus, and through the advance to Kandahar, where he volunteered with the Sapper detachment for Herat. Later on he was with the handful of Sappers which formed part of the small but famous garrison of Kelat-i-Ghilzai. They held out under great hardships, due to the extreme severity of the weather and the attacks of the enemy, until relieved in May, 1842.

In August Hanuman Singh was marching on Ghuznee and Kabul with Nott's Force. He was present during all the fighting *en route* and in the final retirement, *viâ* the Khyber Pass on Peshawar.

In 1845 the First Sikh War broke out. Hanuman Singh, now a Naik, was present at the Battle of Sobraon, and three years later

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in the Second Sikh War, at the Siege of Mooltan and the Battle of Goojerat.

Eight years of peace followed, and then the Mutiny broke out. By this time Hanuman Singh was a Havaldar. He was with the Sappers of Barnard's Force in the advance on Delhi and at the Battle of Badli-ki-Sarai. Throughout the long hot weather of continuous fighting and entrenching on the burning rocks of the Ridge, he played his part well in that seemingly hopeless task. During the siege he was promoted to Jemadar, and at the conclusion was promoted Subadar by the Governor-General and admitted direct into the 2nd Class of the Order of Merit ; a most unusual recognition of repeated and conspicuous acts of gallantry.

Delhi was captured and the ultimate result was no longer in doubt, but much remained to be done. Hanuman Singh took his company to the Capture of Lucknow. He served at the action of Roorya, the Capture of Bareilly, and the campaign in pursuit of the rebels at N. Oudh in 1858-9. In 1863 he became Subadar-Major of the Corps, a position which he held till his retirement, seven years later after 46 years service. Some of his descendants are serving in the Corps to the present day.

3. SUBADAR-MAJOR BASAWAN SINGH, I.O.M., SIRDAR BAHADUR, BENGAL SAPPERS & MINERS.

A Tshattriya of Pertabgarh, enlisted in the Bengal Sappers & Miners on 28. 8. 1840.

These were busy times, and in 1843 he was under fire in the Battle of Punniar in the Gwalior Campaign. Next year came the First Sikh War, and Basawan Singh was present with his company at both Moodkee and Sobraon. Two years later he served in the Second Sikh War. At the close of these campaigns he was, however, still only a Sepoy (as the Native Sapper was then called). But the Mutiny gave him a chance of showing the stuff of which he was made. He was one of those who remained staunch and accompanied Lieut. Maunsell (now General Sir F. R. Maunsell, K.C.B., Colonel of the Corps), to the Siege of Delhi.

Here he volunteered with his cousin Hirpal Singh (later one of the Kashmir Gate explosion party) to go into the city on intelligence work. He was identified by the mutineers and tied to a gun, but by great luck, in the confusion of an attack, succeeded in getting loose and escaping. For his services on this and subsequent occasions he was promoted from Sepoy to Jemadar direct—an unprecedented distinction.

It is unnecessary here to refer to the services of the Engineers and Sappers at the Siege and in the Capture of Delhi, but Jemadar Basawan Singh was awarded the Order of Merit (3rd Class) for gallantry during these operations.

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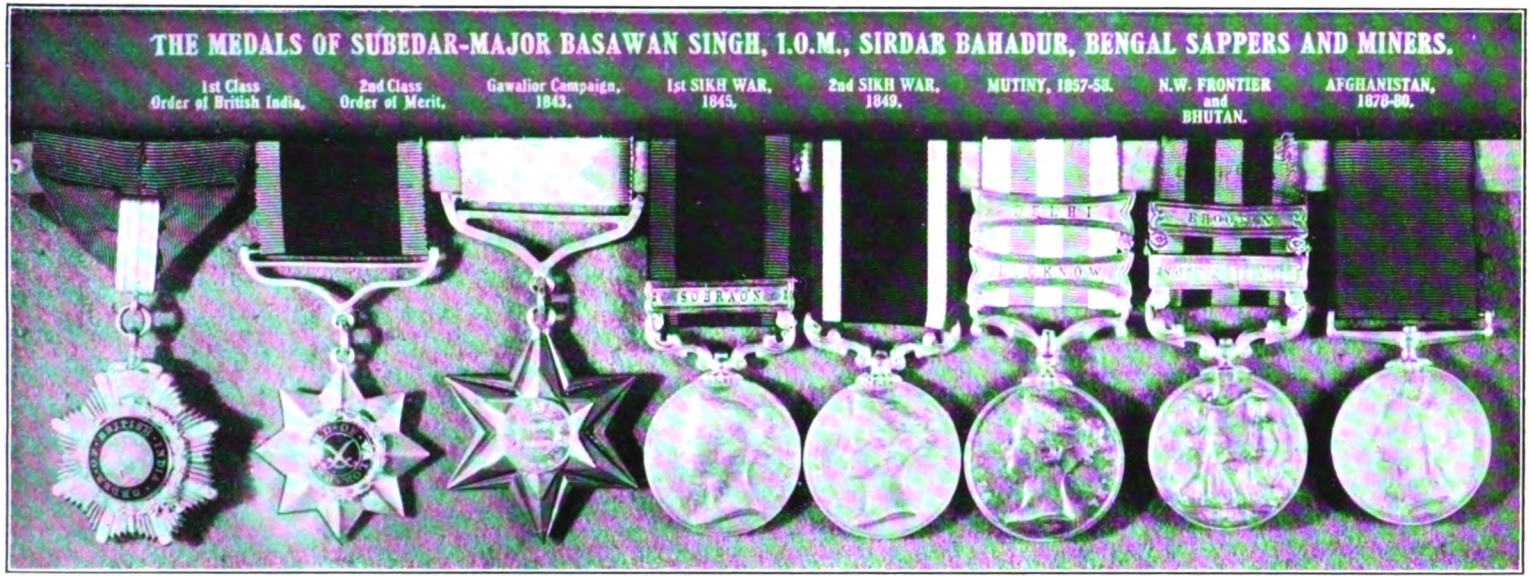
THE MEDALS OF SUBEDAR-MAJOR BASAWAN SINGH, I.O.M., SIRDAR BAHADUR, BENGAL SAPPERS AND MINERS.
1st Class Order of British India.
2nd Class Order of Merit.
Gawalior Campaign, 1843.
1st SIKH WAR, 1845.
2nd SIKH WAR, 1849.
MUTINY, 1857-58.
N.W. FRONTIER and BHUTAN.
AFGHANISTAN, 1878-80.

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Subsequently he served with the Lucknow Relief Force, was present at the Capture of Lucknow, and later throughout the operations in Rohilkand in 1858.

In 1864 the Bhutan War broke out. Basawan Singh was now Subadar of the 7th Company, which proceeded to the front. The company was with the right column which took Dewangiri on 10th December, and formed part of the garrison left behind to hold this post. This garrison consisted, in addition to the 7th Company, of two guns of the Eurasian Artillery Company, a small detachment 14th Bengal Cavalry, and one Native Infantry Regiment.

When, on the night of 29th—30th January, 1865, a sudden and unexpected attack was delivered by an overwhelming force of Bhuteas, it was upon the Sappers' end of the camp that the brunt fell. To quote the despatch of the Officer Commanding the Force: "At 4.30 a.m. yesterday this post was attacked by a very large force, which evaded the pickets by coming through the jungle, completely surrounded the hill and rushed simultaneously into the camp on all sides. The chief attack was made on the flank occupied by the Sappers & Miners, who most gallantly held the enemy in check until I was able to go to their support, when, on charging the enemy, they fled in great confusion from that end of the hill, leaving many killed and wounded on the field. In the first attack on that quarter, I deeply regret to say that Lieut. Urquhart, R.E., fell mortally wounded by a gunshot whilst gallantly leading his men to the attack . . . Subadar Bassawan Singh and Havaldar Bissonath Tiwari of the Sappers & Miners contributed greatly to the successful manner in which the whole body of that Corps so resolutely held the enemy in check for nearly an hour (until supports arrived) by their courage and good example. In fact the whole body of the Sappers distinguished themselves much."

The command of the company had now devolved on Subadar Bassawan Singh. The post was closely surrounded by the enemy and the water supply cut off. On the 2nd February a sortie was made, led by the Sappers, but owing to the refusal of the infantry to advance in spite of the efforts of their officers, the Sappers lost very heavily and the attempt was unsuccessful.

The infantry regiment behaved extremely badly all through and by the 4th, when the O.C. called a Council of War, they were hopelessly out of hand. The Council of War finally decided to retreat. The retirement commenced at 1 a.m. on the 5th, the Sappers with the handful of Bengal cavalry forming the rear guard. As far as the main body was concerned the movement very soon degenerated into a mere panic-stricken flight. The wounded were abandoned, guns thrown into a nala, all baggage lost, and every vestige of discipline disappeared. Bassawan Singh however covered the retirement and held off the pursuit. He not only succeeded in fighting

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his way out, but reached the plains in perfect order, bringing in all his wounded with him, and without a single man missing. The company had lost 20 per cent. of its strength in the fighting. Bassawan Singh had already won the Order of Merit at Delhi, and he was now raised to the 2nd Class, and three men of the company were awarded the 3rd Class of that order.

In the official enquiry held on this affair, which resulted in the disbandment of the infantry regiment in question, the Sappers came in for the highest praise. Brig.-General Tombs, V.C., C.B., commanding the Right Column, refers to them in his despatch as "a most gallant body of men, who covered themselves with glory on the night of the attack on Dewangiri, and whether working with the spade or fighting with their carbines, are equally efficient."

Bassawan Singh and the 7th Company had the satisfaction of taking part in the assault and re-capture of the post they had striven so hard to defend, and at the re-taking of Dewangiri on 2nd April, 1865, two more Sappers were awarded the Order of Merit for gallantry.

In 1873 Bassawan Singh, now Subadar-Major of the Corps, received the Order of British India (2nd Class), and in this position—the highest to which native ranks can attain—he was lucky to see active service once more in the first phase of the Second Afghan War.

In 1879 he took his pension after 38 years of adventurous service during which he received six war medals with five clasps, and the Order of British India; was twice decorated for gallantry, and was promoted through three grades in the field and given a commission for his performance of perhaps the most difficult and dangerous duty for which a soldier can volunteer in war time. He was a man of great personality and strong individuality, about whom anecdotes are current in Roorkee to this day.

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MOUNTING BRISTOL BOARDS AND DRAWING PAPER ON PLANE-TABLES FOR THE FIELD.

By CAPT. R. H. PHILLIMORE, R.E.

(Transcribed from the Records of the Survey of India by kind permission of the Surveyor-General).

THE distortion of field sections is a great hindrance to rapid fair mapping, laborious processes for its elimination being necessary.

When a field section remains true to projection, the north and south lines having expanded or contracted equally with the east and west lines, then it can be so enlarged or reduced by photography that its graticule exactly fits the truly projected fair sheets. Detail may then either be printed direct on to the fair sheet or transferred straight from the photographic prints to the fair sheet.

When, however, the plane-table section has expanded or contracted more in one direction than in the other, the photographic enlargements or reductions will remain distorted, and cannot be directly transferred to the fair sheet. The processes of transferring all detail by specially prepared traces during which the distortion is eliminated, take 5 to 6 weeks for each fair map. Special traces have to be prepared for the hill sheet and for the outline sheet. It is to save this expenditure of labour that endeavours are being made to mount the field section on the plane-table so that it shall not distort.

Any paper or thin board which is pasted firmly down on a wooden plane-table over its whole area, will expand and contract with the plane-table. The wooden plane-table expands and contracts more across the grain than it does with the grain; hence the distortion of any graticule drawn on the mounted paper. The writer has tried mounting Bristol boards by pasting them firmly down on the plane-table, and the graticules were found to distort just as much as with drawing paper.

To mount either drawing paper on Bristol boards by pasting them firmly down along the edges and leaving them free otherwise, results at once in "cockling," for paper does not naturally expand or contract equally with the wooden plane-table. The paper is more absorbent than the plane-table, and it is also more readily affected by the direct rays of the sun.

During season 1911–12, Major Beazeley, R.E., in No. 9 Party used a special paper mounted on stiff canvas which was pasted on the plane-tables round the edges, and it was hoped that would not cockle so much as ordinary drawing paper, being less absorbent. It did cockle a good deal; the paper was of poor quality, would not stand

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erasure, the resulting field sections being very dirty and many almost illegible. But there was no distortion of graticule at all; the photographic enlargements exactly fitted the true projections on the fair sheets. Sufficient blue prints of the enlargements were obtained for:—

(*a*) Direct transfer of outline detail to outline sheet. (*b*) Entering up names for typing. (*c*) Direct transfer of hill detail to hill fair sheet. No special adjusted traces had to be prepared.

In order to get the advantages of this direct mapping and transferring and to avoid the cockling, the field sections of No. 9 Party have been mounted this season by pasting one edge of the paper or Bristol board firmly to the plane-table and leaving the other three edges lightly held down by cloth but free to expand or contract. No. 9 Party is carrying out supplementary survey over an area that has been recently surveyed cadastrally. The 1-in. reductions of cadastral maps are supplied printed in grey, on 210 lbs. drawing paper mounted on cloth. Bristol boards are used for some field sections.

Both Bristol boards and the cloth-mounted drawing paper are being mounted in the following way:—

The field section is fastened firmly along one long edge of the plane-table by a strip of cloth pasted firmly round the edge of the board. The other three sides of the field section are cut so as to leave a half-inch margin of plane-table round them. Strips of cloth are then pasted along these three edges, along the upper surface of the field section and along the underside of the plane-table only. The cloth must not adhere to the plane-table at all along the half-inch interval between the edge of the field section and the edge of the plane-table. The cloth is stretched tight when mounting and the field section must not be wetted. If the atmosphere now begins to get dry, the wooden plane-table shrinks across the grain more than the field section does and the cloth round the three free edges becomes slack. There is no cockling in the paper or the Bristol board as they are both stiffer than the cloth which binds the edges.

In actual practice some of the field sections were allowed to get stuck here and there along the three edges which were supposed to be free, and cockling has followed. The edges have since been released, and the drawing paper settled flat at once, but it is impossible to get all the cockle out of the Bristol boards. Where the edges had been left properly free to start with, the Bristol boards have not cockled at all.

As the plane-table contracts during the dry weather, the field sections may get inconveniently loose along the free edges. Surveyors have been supplied with adhesive paper, such as is used in repairing music, etc., strips of which can be fastened at intervals round the edges.

Bristol boards or cloth-mounted drawing paper are more suitable than plain drawing paper, being heavier, stiffer, and lying more closely to the plane-table. A board so mounted causes no inconvenience from the slight play between paper and board. This method cannot be pronounced successful till the close of field season, but so far it has worked as expected, except for the accidental dropping of paste along edges which were not supposed to be pasted.

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DELHI DURBAR.

ROADS CONSTRUCTED WITHIN THE DURBAR AREA BY SUPERINTENDENT, DURBAR WORKS, P.W.D., 1911.

THE total mileage of roads constructed and remade amounted to 31·8 miles, out of which 18·7 miles were entirely new road and 13·1 miles were roads widened out and renewed.

These figures do not include roads constructed in the Amphitheatre area.

The work on roads was carried out under numerous estimates which are treated in detail in the following pages. The total expenditure actually incurred on the above mileages was Rs.3,19,605 and if we calculate out the mileage reduced to a uniform width of 10 ft., it amounts to 56·8 miles which gives a rate of Rs.5,627 per mile or just over Re.1-1- per foot-run, and considering the high rates prevailing on account of large demands and extreme shortage of time, this is a very moderate rate indeed. Inclusive of the roads constructed separately by Superintendent, Durbar Works, in the Amphitheatre, King's Camp, and Foreign and Administration Camps, the total length, at a normal width of 10 ft., amounts to 68·4 miles, and total expenditure to Rs.3,78,000.

Each road referred to in this report will now be described, and attached there is a statement which gives detailed information for all roads in tabular form.

IMPROVING AND WIDENING DURBAR ROADS (ITEMS NOS. 1 TO 9).

This estimate amounting to Rs.2,47,393 was sanctioned in the Durbar Committee's No. 3513, dated 2nd May, 1911, and provided for the following :—

1. *Alipur Road* (*The Mall*).—This road commenced at its junction with Rajpur Road and extended to the Grand Trunk Road, between which two points it was called " the Mall." From the Rajpur Road Junction to the Khybar Pass through the Ridge the roadway was made 50 ft. wide, and from there on to its Junction with Kingsway it was constructed to a width of 40 ft. with a 4½-in. layer of kankar metal laid over a 4½-in. soling coat where this latter was required. The original road here was only 20 ft. wide and had been cut to pieces by the preliminary traffic. The estimate only allowed for a width of 30 ft. but owing to the enormous increase of traffic it was

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decided by Superintendent of Works to have a 40-ft. width and this was carried into effect.

From Kingsway crossing to Princes' Road crossing the width of metalling was kept at 30 ft. as there was less traffic over this section and there were no side walks to restrict the roadway. From the latter point to the junction with Empress Road the metalling was reduced to 16 ft., and again to 12 ft. from there to the end of the road at Azadpur. In the latter two lengths soling was not necessary. The District Board had undertaken to repair the portion of the road from Princes' Road crossing to the Grand Trunk Road, but in the end, in order to get the work completed in time, the Superintendent of Works took the work in hand. The total length of the Mall was 15,693 ft. and the details of the several reaches between the various crossings are shown below*. The cost excluding that portion done for the District Board was Rs.21,858 and against a separate estimate of Rs.3,296 sanctioned for the latter piece, the actual expenditure amounted to Rs.3,097, so that the total cost was Rs.24,955.

2. *Kingsway.*—This road formed the processional route to the Amphitheatre extending from the King's Camp and a width of 30 ft. was maintained the whole way. The original width was 16 ft. and as some extra soling was required a thickness of 4½-in. stone ballast was provided. The length was 12,924 ft. and the thickness of kankar metal 4½ in. The cost amounted to Rs.34,039.

3. *Princes' Road.*—This was the return processional route from the Amphitheatre to the King's Camp joining into Kingsway at the Gwalior Fountain. The width was kept at 20 ft. for the first portion, that is from the Amphitheatre to the junction with the Mall, and as over this length the remains of an old Durbar road of 1903 were followed here and there, a full soling coat throughout and over the whole width was not necessary, and in many places only an extension of 4 ft. on either side was given. The last portion of the road from the Mall past the Polo Grounds to the junction with Kingsway at the Gwalior Fountain was a brand-new road 30 ft. wide. A travelling coat of kankar 4½ in. thick was laid over both portions.

The length from end to end was 12,370 ft. and the cost Rs.25,544.

4. *Chauburja Road.*—In the estimate the (*a*) Chauburja Road included the (*b*) Imperial and (*c*) Central Avenues. The first portion, known as Chauburja Road proper, extended from the Rajpur Road over the Ridge down to Circuit House Road, and was made 20 ft. wide, the length being 3,800 ft. A travelling coat of 4½-in. kankar was provided with soling where necessary. Imperial Avenue

* (*a*), From Rajpur Road to Kingsway, 40 ft. and 50 ft., 6,596 ft.; (*b*), from Kingsway to Princes' Road, 30 ft., 3,290 ft.; (*c*), from Princes' Road to Empress Road, 16 ft., 3,637 ft.; (*d*), from Empress Road to G.T. Road, 12 ft., 2,170 ft.; total feet, 15,693.

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extended from Circuit House Road to the corner of the Central Provinces Camp, measuring 3,776 ft. Here a soling coat together with a travelling coat 20 ft. wide by 4½ in. thick was provided for the whole width.

Central Avenue extended from this corner of the Central Provinces Camp up to the Mall, a length of 2,663 ft., and here again the width of 20 ft. was maintained throughout with a 4½-in. coat of kankar overlying a stone ballast soling coat. Both these avenues have been classed as new roads and their cost together with Chauburja Road was Rs.24,306.

5. *Military Road.*—This was a new road from end to end. It ran along the toe of the Ridge from the Mall to the Musjid at Wazirabad, and then turned to the west and ran straight across to meet Kingsway at Dahirpur. The total length was 14,960 ft. and the width 16 ft. Throughout the length a 9-in. boulder foundation was provided as the ground traversed was for the most part either loose sand or boggy soil. From the Mall to the junction with Coronation Road a layer 4½ in. of stone metal was provided as a travelling coat and the portion between the Sapper Bridge on Island Road and Coronation Road was consolidated with a blinding of 1½-in. kankar, in order to make it set better for the King to travel over when going to the Parade Service in camp. The length between the Coronation Road and Dahirpur was given a 4½-in. travelling coat of kankar to make a better surface for the fast traffic passing over this section. The total cost amounted to Rs.43,064.

As the Military Road had to cross the Najafgarh escape between Wazirabad and Dahirpur the construction of some kind of bridge over the nala was necessary, and it was decided to erect a pile bridge, as the soil of which the banks were formed was of a very soft sandy composition and no suitable foundation could be made quickly and cheaply for masonry abutments. The bridge had a waterway of 20 ft. and was designed to carry a steam roller.

The total span between the crests of the banks was 34 ft. and the bed of the stream was 9 ft. below the level of the banks. The banks were very steep, and the stream liable to floods which overtopped the banks after severe rain.

As no contractor could be induced to take the contract on reasonable terms, the bridge was constructed by one Pioneer carpenter assisted by unskilled coolies.

Sixteen sal wood piles 9-in. diameter were driven in by a pile driver with a 30-ft. drop for a 1½-ton monkey.

The abutments consisted of a double row of piles boarded in with planking and filled with earth. Girders 34 ft. long of 18 in. by 7 in. by 75 lbs. section were used and slung across, using the pile driver as a derrick and the ends fixed down to cross beam, bedplates resting on the cribwork.

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Trough plates 4 in. deep were then laid across the girders and bolted down to them, the roadway consisting of rammed earth filling with stone ballast blinded with kankar consolidated thereon.

The banks were protected with some dry stone pitching and by galvanized corrugated-iron sheets, and the bridge stood a heavy flood and the passage of steam rollers without showing any signs of scour or settlement, but it was as well that this precautionary style of construction was adopted as the pile bridge on the Light Railway near by which was of less substantial build, was affected by this same flood. The bridge cost Rs.1,573 all inclusive.

6. *Azadpur Road.*—This followed the general alignment of an old road extending from Azadpur to Pembari Bridge on the Western Jumna Canal. It was widened to 16 ft. and a travelling coat of kankar (4½ in. thick) provided. The length measured 7,625 ft., and cost amounted to Rs.14,750.

7. *Provincial Road.*—This was over an old unmetalled track and was metalled with 4½-in. stone metal of 2-in. gauge. It extended from Pembari Bridge up to the Grand Trunk Road to the west of Subzimundi and ran past the village of Wazirpur, serving all the Provincial Camps located out in that area. It measured 14,564 ft. in length and was 12 ft. wide, the cost amounting to Rs.15,398.

8. *Ridge Road.*—This was an existing road repaired with a 4½-in. renewal coat of kankar 12 ft. wide. It commenced at the Chauburja Mosque and ran along the top of the Ridge past the Flagstaff Tower down to the Mall near the Khybar Pass. Its total length was 4,644 ft., but of this only 2,728 ft. were fully renewed, the remainder (from Flagstaff Tower to the Mall) being repaired. The cost amounted to Rs.5,796.

9. *Review Ground Roads.*—These were four in number. (*a*), Empress Road; (*b*), Parade Road; (*c*), Marsh Road; (*d*), Review Road.

(*a*). *Empress Road.*—Was 16 ft. wide and ran from the Mall to the Review Ground crossing the Durbar Railway main line and Army Camp branch by level crossings. It measured 4,655 ft. long and was provided with a 4½-in. thickness of stone metal and 1½-in. kankar blinding.

It was a new road throughout and was the road originally intended as the route for Their Majesties the King and Queen to travel by when going to and returning from the Review and Assault-at-Arms.

(*b*). *Parade Road.*—Commenced from Princes' Road and ran for one straight length of 5,350 ft. out to the Review Ground. It was made 12 ft. wide blinded with a 1½-in. thickness of kankar and has been classified as a new road, but from its junction with Marsh Road to the Review Ground it picked up the general alignment of an old 1903 Durbar temporary road, the remains of which were found and made use of for soling purposes.

(*c*). *Marsh Road.*—Took off from Parade Road at the south-east

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corner of the Review Ground, and followed an old alignment to the Amphitheatre as far as the Army Camp branch of the railway, but instead of crossing it ran along parallel to the line as far as the middle of the Spectators' stand. This latter portion (*i.e.* from the railway to the Spectators' mound) was, however, only cleared and dressed. The portion metalled was made 12 ft. wide with a 3-in. coat of new metal. The length was 1,900 ft.

(*d*). *Review Road.*—Followed an old alignment from the Grand Trunk Road (at Azadpur Village) to the Review Grounds. It was 2,700 ft. long and had a width of 12 ft., a new 3-in. coat of stone metal being provided. The total cost of these Review Ground Roads amounted to Rs.23,134.

10. *Najafgarh Canal Road.*—The southern half of this road followed the Najafgarh Canal and there were remains of previous metalling on the portion between the junction with the Mall and the Grand Trunk Road. It was made up to a width of 16 ft., and a travelling coat of kankar 4½ in. thick was provided. Its length was 6,178 ft. The northern half between the Mall and the Military Road was extensively repaired and partially metalled for a length of 6,900 ft. The expenditure on the whole road amounted to Rs.13,342.

This comprised all the roads sanctioned under this estimate, and the actual expenditure amounted to Rs.2,31,647 against the sanction of Rs.2,47,393, giving a saving of Rs.15,779.

11. *Central Camp Roads.*—The estimate amounting to Rs.10,525 was sanctioned in the Committee's No. 7043 D, dated 12th September, 1911, for the construction of small roads about the Central Camp area as follows :—

(*a*). *Malkaganj Road.*—From the Grand Trunk Road following an old alignment to the Rajpur Bridge having a length of 8,810 ft. and a thickness of 4½-in. stone metal laid 12 ft. wide. This road took all the heavy traffic from Subzimundi.

(*b*) and (*c*). *Approaches to the Kashmir and Baroda Residents Camp.*—These were 305 and 964 ft. long respectively and 12 ft. wide, with a thickness of 4½-in. stone metal blinding with kankar.

(*d*). *Bandstand Road.*—Followed an old alignment for the greater part of the way, and extended from the north-west corner of the Polo Ground (where it met Princes' Road) to the Grand Trunk Road. It was 2,890 ft. long, and 12 ft. wide, and a coat of 4½ in. of stonemetal blinded with kankar was provided.

(*e*). *Foreign and Administration Camp Roads.*—Were really minor service roads connecting Princes Road with the Mall on either side of the Foreign and Administration Camp. They were together 2,645 ft. long by 12 ft. wide with a 4½-in. coat of metal blinding with kankar.

The actual expenditure on these roads all taken together amounted to Rs.10,068, giving a saving of Rs.457.

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12. *Constructing a Road from Kingsway across the Dahirpur Plain to Princes Road.*—This was sanctioned for Rs.2,355 and was called the Dahirpur Road. It was 2,700 ft. long by 10 ft. wide with a coat of 4½-in. stone metal blinded with kankar. Together with Parade this road formed the Royal Route to the Review Ground. The actual cost amounted to Rs.1,505 so that there was a saving of Rs.850.

13. *Coronation Road.*—An estimate amounting to Rs.22,394 was sanctioned in Secretary's No. 3414/D, dated 29th April, 1911, to construct a road from the Alipur Road (The Mall) through the Indian Chief's Camps to meet the Military Road, and this took the name of the Coronation Road. It was 6,636 ft. long, by 24 ft. wide with raised sidewalks 10 ft. wide on either side. The soling was of stone ballast 4½ in. thick, and a layer of kankar 4½-in. thick was provided as a travelling coat. The raised sidewalks were of earth covered with bajri and a kerb of brick-on-edge ran the whole length.

The actual cost amounted to Rs.22,916. This road was found to be much too narrow as very heavy continuous traffic was thrown on to it.

14. *Bela Road.*—This road was intended as an alternative route to the Fort to relieve the congestion of traffic through the Kashmir Gate, and it took for its alignment the old bed of the river Jumna just outside the city walls and underneath the Kudsia Bagh, which at the time was an impenetrable jungle of heavy grass and undergrowth.

It was sanctioned for Rs.23,014 in Secretary's No. 363/D, dated 25th February, 1911.

The earthwork was carried out by Pioneer labour and well consolidated before the soling of 4½-in. stone metal was laid. A travelling coat of 4½-in. kankar completed the roadway. The length measured 5,492 ft. and the travelling width was 32 ft. of which 16 ft. were metalled. Owing to the subsoil water level being high and foundations being very boggy, it was necessary to construct the culverts of this road on shallow wells rectangular in plan and sunk to a depth of 8 ft., which were filled in with stone-ballast concrete and well rammed. As only ordinary concrete foundations had been provided for in the first place, these culverts were considerably underestimated, and alone gave an excess of Rs.3,200, but the risk of the severe damage by flood was very great and the extra expenditure therefore fully justified.

The actual expenditure amounts to Rs.27,836, giving an excess of Rs.4,822 over the estimate, which is accounted for as follows :—

1. Culverts as above Rs.3,200.

2. The length was increased by 300 ft. in order to join up completely.

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3. Heavy clearing and extensive draining had to be done in carrying out the work.

15. *Constructing a Road round the Ends and on the Sides of the Polo Ground.*—An estimate amounting to Rs.4,275 was sanctioned for the construction of roads around the south and west of the Polo Ground to complete the connections with Princes and Bandstand Roads and the road from Rajpur Village.

These roads were constructed 12 ft. wide with 4½-in. thickness of metal, length being 3,270 ft.

They were most useful in opening up communications and disposing of the traffic on Polo days, and minimized the congestion on Princes Road. The cost amounted to Rs.4,213.

16. *Circuit House Road.*—An estimate amounting to Rs.2,008 was sanctioned to put Circuit House Road in order. Originally it was intended to close this road to all traffic, but eventually it was found necessary to keep it open for the convenience of the public, and overhauling was ordered as it had become much cut up. A layer of 3 in. of kankar was laid over a width of 12 ft. from its junction with Chauburja Road at the foot of the Ridge up to the Mall, a length of 3,947 ft. The cost amounted to Rs.2,012.

17. *Provincial Road.*—A supplementary estimate of Rs.3,771 was sanctioned in connection with the metalling of the "*Kacha*" road from the Pembari Bridge to the Grand Trunk Road, as the alignment estimated in the former estimate was revised and this extra allotment was necessary. The expenditure amounted to Rs.6,172 showing an excess of Rs.2,401.

18. *Extension of Malkaganj Road.*—An estimate of Rs.827 was sanctioned to extend the Malkaganj Road from the Rajpur Bridge to the south-west corner of the Polo Ground. This was carried out by giving a 12-ft. road and 4½-in. thickness of metal, the length being 1,405 ft. and the cost amounting to Rs.793.

19. *Extension of Imperial Avenue.*—Estimate sanctioned for Rs.850 to extend the Imperial Avenue from its junction at the right angle bend with the Central Avenue to meet the Malkaganj Road at Rajpur Bridge. A 12-ft. road with metal of 4½-in. thickness was constructed, the length being 828 ft. and the cost Rs.672.

20. *Provincial Camp Station Road.*—Estimate sanctioned for Rs.1,485 to construct an approach road to the Provincial Camp Railway Station from the Provincial Road taking off to the east of the Baluchistan Provincial Camp. A 10-ft. road was provided with metal of 4½-in. thickness, length being 1,843 ft. and cost Rs.1,363, giving a saving of Rs.480.

21. *Massed Band Road.*—An estimate for Rs.776 was sanctioned to provide an approach to the Massed Band Camp from the Mall. It had originally been intended to join up by a direct road taking off opposite the Mubarikbagh, but as the Band Camp was shifted out

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further to the west an unmetalled track was made on this alignment instead, and the metalled road was constructed to join into Empress Road. A 10-ft. road was provided with metal of 4½-in. thickness length being 700 ft. The cost amounted to Rs.669.

22. *Garage Roads.*—An estimate for Rs.1,155 was sanctioned to provide small roads to give access to the Motor Garage. These were made 10-ft. wide with metal of 4½-in. thickness length being 630 ft. The cost amounted to Rs.998.

23. *Petrol Shed Road.*—An estimate of Rs.500 was sanctioned to provide an approach to the Petrol Sheds from Canal Road. A road 510 ft. long by 10 ft. wide with stone metal 4½ in. thick was accordingly constructed the cost amounting to Rs.480.

24. *Approach to the Press Camp from Imperial Avenue.*—Estimate for Rs.1,013 sanctioned. A 10-ft. road was provided with metal of 4½-in. thickness length being 1,100 ft. and cost Rs.980.

25. *Bandstand Diversion.*—Sanctioned for Rs.1,000. A 10-ft. road 970 ft. long was constructed as above at a cost of Rs.905.

26. *Works at the Kingsway Crossing.*—The Committee sanctioned an estimate of Rs.2,239 for the purpose of diverting the Canal course and regrading Kingsway, and metalling the circular portion of the crossing. The diversion was carried out in a cement brickwork channel so as to thoroughly insure against all risks of breaching, and the actual expenditure on the works amounted to Rs.1,800, so that there was a saving of Rs.439.

27. *Repairs to the Rajpur Bridge.*—An estimate amounting to Rs.1,500 was sanctioned for the purpose of carrying out special repairs to the bridge over the Najafgarh Escape near Rajpur Village. Thorough overhauling was necessary after the heavy rains in September, 1911, which brought about the collapse of a wing wall and revealed other slight defects. The wall was rebuilt in cement in order not to take any risks against the increasing traffic during and just before the Durbar. At the same time a few of the flooring planks were renewed and the railing replaced. The actual expenditure came to Rs.1,114 giving a saving of Rs.386.

28. *Sidewalks along the Mall.*—An estimate of Rs.4,687 was sanctioned to construct sidewalks along the Mall up to the Kingsway Junction, in continuation of those provided by the Municipal Department which ended at the Rajpur Road Junction. These sidewalks consisted of a brick-on-edge kerb with a backing of earth well rammed and having 3-in. earthen cross pipes at convenient intervals for the drainage of the gutters. They were kept 10 ft. wide and the walking surface was oiled so as to prevent dust, this arrangement proving very effective and being much appreciated by natives walking bare feet. The actual expenditure amounted to Rs.4,712.

29. *Traffic Roads at the Review Grounds.*—An estimate amounting

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to Rs.7,997 was sanctioned to construct roads in connection with the Review Ground Pavilions, in order to facilitate traffic arrangements for the arrival and departure of the spectators, and for the convenience of the parking of carriages, and the combined length of road thus constructed was 8,665 ft.

The width was kept at 10 ft. and 4½-in. stone ballast was laid and consolidated with earth as a blinding; over this a layer of bajri of 1½-in. thickness was spread to a total width of 20 ft. The actual cost came to Rs.6,151, so that there was an appreciable saving of Rs.1,146.

30. *Collection of Metal for Repairs.*—As the few existing roads within the Durbar area were subjected to heavy traffic from the outset of operations, it was imperative to lay in a stock of kankar immediately with which patch and surface repairs could be carried out in order to keep the roads open to traffic. An estimate amounting to Rs.32,000 was accordingly submitted which was sanctioned in Secretary's telegram, dated 5th February, 1911, and with these funds the roads were kept going up until such time during and after the rainy season (the monsoon of which failed conspicuously in the Durbar area) as the wholesale renewals and constructions aforementioned were carried out.

The expenditure amounted to Rs.30,105 excluding a remaining stock of metal, which cost Rs.2,149, which has been handed over at price value to Superintendent, Temporary Works, for the upkeep of the roads constructed in connection with Durbar operations.

31. *Processional Routes.*—An estimate amounting to Rs.28,588 was sanctioned to provide sidewalks along Kingsway and Princes Road which formed the Processional routes to and from the Durbar Amphitheatre. These sidewalks were constructed of well-rammed earth raised to a height of 4½ in. to the north of the Mall, and 7½ in. to the south of the Mall. In both cases the kerb was constructed of brickwork, except for that portion of Princes Road lying to the north of the Mall, which consisted of 1-in. riser planking screwed to pegs and painted red. This was done as there was a shortage both of bricks and of brick masons. These raised sidewalks were 10 ft. wide and had a surfacing layer of bajri. The actual expenditure on this work amounted to Rs.40,324 or Rs.11,736 in excess of the estimate which was accounted for as follows:—

1. Length of nearly 500 ft. was omitted from the estimate.

2. Extra "*bajri*" was required to maintain the sidewalks in good condition and give them a finishing coat just before Durbar day.

3. General maintenance and cleaning up was excessive immediately before the Durbar and during the actual period, owing to other departments and the neighbouring camps making the road sidewalks

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a dumping ground for any odds and ends of materials they had no use for, and wanted to get rid of.

4. The earthwork had been much underestimated as the construction of the pavements necessitated filling old roadside drains and hollows, and making new drainage arrangements.

32. *Widening Azadpur Road (The Mall) from Princes Road to Azadpur.*—This estimate was sanctioned amounting to Rs.3,296. The metalled width of the portion of the Mall from Princes Road to Empress Road was widened to 16 ft. and of that beyond up to Azadpur it was renewed to 12 ft. The expenditure on this estimate amounted to Rs.3,097, and the work was taken over from the District Board's Engineer.

33. *Minor Improvements to Processional Routes.*—Sanctioned for Rs.1,000. Extensive improvements were called for from all sides, and these were carried out by the Nahan Sappers and Miners at an actual cost of Rs.862.

34. *Special Repairs to Durbar Roads.*—This was sanctioned for Rs.1,200 to meet the cost of the petty special repairs to roads, which were necessary, chiefly on account of damage done by heavy bursts of rain after the roads had been made. The expenditure on the same was Rs.1,200 and also comprised drainage works carried out by Pioneer labour.

35. *Constructing and Oiling Marsh Road.*—The estimate for this was sanctioned to improve the "*kutcha*" road from the end of the Marsh Road to the Railway platform at the back of the Amphitheatre. Earthwork was done by Pioneers, and such small amount of oiling as was done was charged off to the Oiling Roads Estimate, and hence there has been a very small expenditure of Rs.23 only.

36. *Watering Roads.*—An estimate amounting to Rs.5,834 was sanctioned for the purpose of keeping the roads watered after the rainy season was at an end. It was of the highest degree of importance, after the consolidation and before the work of oiling could be taken in hand, to keep the roads well watered, as the success of a good *kankar* road depends mainly on the surface being kept wet for some time after it has been opened to traffic. The watering was done by means of carts and bhishties, and the actual expenditure incurred amounted to Rs.5,735. These operations were completed successfully as the roads instead of wearing down and becoming dusty continued to improve, and by the time the Durbar came off the surface was in all cases perfectly even and true.

The road oiling operations have been made the subject of a separate report.

Note on Collection of Materials.—Kankar and stone were both required in vast quantities for the Durbar Roads, and this necessitated a large "bandobast" for collection as the roads were required to be ready by the end of October at the latest.

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Stone was excavated on the Ridge at Delhi and was supplied by contractors delivered at site and also at the quarries, the rate of the former being Rs.8 and that of the latter Rs.6 per cent. The carriage question presented the greatest difficulties, and much delay and extra expense could have been saved by a capital outlay at the outset on the purchase of some steam lorries, the solitary one sanctioned doing splendid work and giving excellent value. As it was, something like 400 carts were employed at Rs.3 per day to ply between the Ridge and the sites of delivery. They were required to travel 12 miles a day and carry 33 maunds of materials, and they were paid proportionately for the work done. A mate was placed in charge of 10 to 15 carts and he had a cooly for each cart to help him to load and unload. This was a sure and by a long way the best method of completing the collection, which for stone alone amounted to something like 15 lakhs cubic ft.

In the collection of kankar there was great difficulty as the quarries were mostly 20 to 30 miles out of Delhi. This meant utilizing the Railway as much as possible, and by means of a ballast train placed at the disposal of the P.W.D. by the Traffic Manager, Durbar Railways, and thanks to the ready assistance and valuable help he gave at all times, it became just possible to complete the collection of kankar before a heavy downpour in the rainy season stopped further operations. Contractors were employed to deliver kankar at site for Rs.13 per 100 cubic ft., but as this was not being done nearly quick enough, other arrangements were made out at the quarries to purchase kankar F.O.R., the P.W.D. undertaking the railage and delivery of the materials at site by means of their own carts.

The price of the kankar F.O.R. at these various Quarry Stations was Rs.6/8 per 100 cubic ft. although at Rs.6 at the commencement. Kankar stocks were always measured at 12 in. for a depth of 13 in. actual. Stone ballast at 12 in. for a height of 12 in. Quarries were tapped in the Delhi, Rohtak, Bulandshahr and Meerut Districts.

Most of the kankar came from the Asandoh, Khurja, Rohri and Barokha quarries which provided excellent blue silica kankar. Nearly 13 lakhs of kankar were collected, about half of which was railed in and disposed of by departmental labour and carts. The kankar obtained was throughout of a very superior quality, strict specifications and supervision being insisted on. In fact it is not saying too much to state that the kankar delivered for Durbar public and camp roads was of a much higher standard than ordinarily supplied in the locality.

Notes on Culverts.—Most of the culverts built were of a temporary nature except those on existing main thoroughfares and such as would be permanently useful, for example those on Alipur Road, Bela Road, etc. These latter, as mentioned in the report on the

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road in question, were founded on shallow well foundations sunk to a depth of about 8 ft.

The bridges over the Najafgarh Canal on Kingsway and the Mall which were widened have been dealt with under a special report, and the pile bridge on Military Road has been referred to separately. Galvanized corrugated-iron culverts were used extensively, and these proved to be most efficient and were easy of construction, being merely laid down on a bed of about 4 in. to 6 in. of concrete. They were obtained in truck loads from Messrs. Balmer, Lawrie & Co., Calcutta, and with an overlying cushion of earth of about 18 in. were strong enough to take any sort of traffic including heavy steam rollers, loaded steam lorries, etc.

Temporary culverts were also made as follows :—

1. Flooring of old C.I. railway sleepers.
2. Flooring of ordinary wooden sleepers.
3. Flooring of galvanized corrugated sheet iron laid over odd pieces of old iron rail.
4. One or more lines of cast-iron water or earthenware drainage pipes, according to circumstances.

The cost of culverts was in all cases included in the estimate for the roads concerned.

Notes on Consolidation.—The greater part, in fact 90 per cent. of the kankar consolidation was executed by steam roller as labour was scarce and time was very short. The kankar was spread to a camber of 6 in. in 30 ft. and proportionately for greater or less width. The metalling was rolled once in a dry state beginning from the edges and working towards the centre, so that the section of the metal was maintained as much as possible. After this dry rolling the metal was well watered and the steam rollers turned on with bhishties to keep the wheels wet, so that no pieces of kankar would adhere to the surface of the rollers. This completed the rolling and the surface was then dressed over by hand rammers, or by an 8-ton roller which had a particularly wide bearing surface, which did the finishing work most effectively. This method was found to prove very successful and gave the best results. No mud or screenings were admixed as the pounding of the roller provided all the blinding required.

The same process was resorted to for stone metal except in the final rolling, when kankar screenings, bajri or earth were utilized as a blinding material, of which the first proved by far the best factor and well worth the small extra expense of cartage from the nearest kankar depôt.

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OILING CERTAIN MAIN ROADS, DURBAR WORKS, P.W.D., 1911.

1. THE idea in laying down oil on the road surface is that after the oil contained in the liquid fuel is consumed (partly by evaporation and partly by absorption by the road metal), the asphalte basis of the fuel remains to make the surface more adhesive and elastic, and to preserve the life of the road against the wear and tear caused by crumbling away action which causes mud or dust, as the case may be. A road thus oiled is benefited in two ways :—(*i.*). The road does not require watering in dry weather, since it is rendered absolutely dustless. (*ii.*). It does not need repairs for a considerable time (according to the number of coats of oil applied and the amount of traffic), as the wear of the metal is less and more evenly distributed.

That oiled roads are dustless had been testified to satisfaction in India, in Presidency towns, at the Allahabad Exhibition, and fully demonstrated at Delhi during the Durbar period, where troops on the march and the enormously heavy wheel traffic raised no dust whatever.

2. In this case a matter of 35·25 miles of road, varying in width from 12 to 60 ft., with an area of over half a million square yards, were oiled with two or three coats, only a few roads receiving but one coat.

3. From the commencement of the work on October 14th, to about November 7th, the work was done by half a battalion of the 34th Pioneers, whose assistance in making a start with the operations was of the greatest possible value. They were gradually replaced by civil labour, and, from the middle of November till work ceased on the 11th December, the work was carried out entirely by coolies.

4. Work was carried out in two sections. The City section working from Subzimundi Station and doing all oiling in the city and Civil Lines, and the Camp section working from Kingsway and doing all oiling in the Camp area. One tank wagon containing about 3,300 gallons of liquid fuel supplied by the Asiatic Petroleum Company was delivered at each station every day. The oil was generally pumped direct into the carts (ordinary watering carts with the sprinklers removed) by which it was taken on the road, but in order to guard against irregularity in arrival of the wagons or disposing of their contents, storage of 5,000 gallons at Subzimundi and 7,000 gallons at Kingsway was provided. At each station there was a mistry, supplied by the Asiatic Petroleum Company, whose duty was to adjust the pump on the tank wagons and to make all repairs to the

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valves of the watering carts which were continually getting out of order ; and there were also six men for filling the carts.

When the coolies were employed the services of two non-commissioned officers and six sepoys of Pioneers were obtained to take charge of the spreading of the oil, and were assisted by a certain number (eventually seven) of ex-sepoys, who proved of the greatest use, both on the spreading and in detached work for which their intelligence and habit of obedience made them far more fitted than any ordinary mates or jamadars.

At the commencement of the work the bullockmen, who were paid at daily rates, being taken from watering roads and accustomed to work in the morning and evening, gave a lot of trouble ; they turned up after and went away before the Pioneers, moved very slowly, and had to have sepoys with them to prevent them from running away. After a fortnight of this piece work payment was introduced. On bringing up a full cart load of oil the carter received from the Native Officer or N.C.O. in charge a ticket of the value of 6, 8, 10 or 12 annas, according to the distance covered ; the value being adjusted so that each man could easily earn about Rs.1·8 a day. Every two or three days the tickets were collected, checked, paid for, and destroyed. The inauguration of this system practically ended all trouble with the cartment.

5. Storage tanks of about 600 gallons capacity for the liquid fuel (petroleum residium) are the most convenient for the purpose, and the liquid is run straight from the railway tank wagons or pumped up into them, six such storage tanks being required to take the ordinary capacity of each railway tank wagon, which is about 3,300 gallons. A railway tank wagon can be emptied conveniently in about 24 hours, so that a sufficient number of storage tanks should be available, otherwise demurrage charges will be made, adding considerably to the cost of operations.

Ordinary cylindrical road watering tank carts of 120 gallons capacity with the sprinklers removed are suitable to pour the fuel on the road surface. A large four-wheel tank cart of 350 gallons capacity was also found useful as a temporary depôt cart.

For each section of operation four tank carts are required, so that while two carts are being emptied the other two carts will be filled in order that no time may be lost in waiting for the carts, each section of road oiled being commenced at either end thereby employing the two carts at a time. This method gives the quickest results.

Eight bass brooms obtained from the Cawnpore Brush Factory were satisfactorily used with each tank cart, the average half width of roadway being 10 ft. This allows four men to work in a row immediately behind the tank cart and four behind these to carry forward any oil that would possibly lodge or run off.

Only 16 broom handles are necessary, the same being fixed into

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new broom heads when the old ones are worn out. A broom handle ought to be about 4 ft. long. The broom head lasts about 10 days in the operation with ordinary care. It is necessary to have three dozen broom heads per section of road in stock so as to without delay replace those that wear out. Ordinary sweepers' brushes sweep much cleaner than brooms.

The valve of the cart being raised the oil is allowed to run out sufficient to be spread over the width of roadway. The valve is then shut off and the cart moved on to allow the brooms to play, the half width of roadway being thus smeared with the oil, after which, as before stated, four brooms in front and four behind these are plied to give the road an even coating of oil, and at the same time to prevent lodging of superfluous oil which does not work in and leaves pockets of excess oil. Immediately that quantity of oil is sufficiently and evenly spread over the roadway, the tank cart valve is again opened and the process continued as before. The oil should be let out from the cart on the last patch of oil already spread; if dropped too far forward it has to be pulled back and time is lost.

In order to prevent the formation of pools the road should be oiled before ruts have had time to form, and it is very convenient to oil the road immediately after making it, and before opening it to traffic. As the oil naturally tends to run down into the gutters it should be dropped on the crown of the road, and it is as well to tell off a couple of men to bring along with their brushes all oil that gets into the gutter. Always oil down hill, if possible, so as to make it easy to carry off surface oil.

It is usual to mix 5 per cent. of coal tar with the liquid fuel for the second and third coatings in order to obtain better wearing results, but this method of oiling was not adopted for the Durbar Roads, as lasting value was of no consideration and rapidity of execution of the work was essential so as not to block traffic.

6. Sand may be lightly sprinkled over the second and third coatings, and this was done by means of an ordinary labourer's basket for carrying earth, which, after being filled with sand, is shaken up gently (so as not to allow too much sand on any one spot) and the sand allowed to fall through as from a sieve. The object of sand showering is to prevent too much of the fuel being evaporated, and to duly soak the road metal. The sand being heavily loaded with oil does not rise under traffic. As a matter of fact on the Durbar Roads sand sprinkling was not carried out to any great extent.

7. It is best to close the road to traffic altogether, but if not possible to do so, then :—(*i.*). The oiling should be done in sections, half the width of the road at a time, so as not to block traffic. (*ii.*). The oiled portion of the road should be closed to all traffic for 12, 24, and 36 hours for the 1st, 2nd, and 3rd coats respectively, to allow the surface to dry. (*iii.*). It is as well when sweeping the

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road surface to remove the dust well away from the road and deposit it in a ditch or hole. (*iv.*). When admixing tar, first mix the tar and oil in a drum to prevent clogging of the pipe in the tank cart, as if a full tin of tar is thrown into the tank cart and then stirred the pipe gets blocked. (*v.*). For a road 1 mile long and 12 ft. wide the following amount of the liquid fuel is required :— 1st coating, 10 tons; 2nd coating, 5 tons; 3rd coating, 4 tons—at Rs.40 per ton at Calcutta; and the cost of 19 tons being Rs.1,130 at Delhi, the rate for purposes of estimation may be taken at 2 annas 6 pice per square yard for 3 coats or 2 annas for 2 coats. (*vi.*). The crude oil was supplied at the current market rate per ton F.O.R. Budge Budge, in full railway tanks, and the unloading and laying operations carried out by P.W.D. gangs. It was not considered satisfactory to entrust such work to contractors as the work was carried on at all hours of day and night according to traffic requirements and time of arrival of tank trucks, and supervision would have been difficult, and risk of breakdown too great.

Forty-six labourers, with two mates, are required for the work, and they were told off as follows :—

Sixteen men on the brooms at each end of the section being oiled, working in relief, eight at a time, controlled by a mate, four at the storage tanks for filling tank carts with the fuel. Two men at each end of the section being oiled for showering sand, and eight men at each end of the section being oiled to sweep off the overlying dust prior to oiling. The whole gang should be supervised by an Overseer.

The proportion of coolies employed on sweeping varies according to the amount of dust, from about a quarter up to as much as three-quarters of the total number at work.

8. The following remarks apply only to kunkar roads which formed practically the whole of the roads oiled at Delhi in connection with the Durbar :—

It is essential that the road to be oiled, if it is to carry heavy traffic, should be made of the hardest kunkar procurable, especially if traffic is going to go over it before the oil is quite dry, and the less earth used for blinding the better. If soft kunkar is used the heavy traffic will quickly cut it up, particularly if it is not well set, and not quite dry right through.

The surface of the road should be swept quite clear of all dust before the oil is put down, and if the dust is thick it may be necessary to go over the surface two or three times to get it clean enough. Only where the kunkar is very soft and traffic cannot be stopped can a little dust be left without harm.

The first result of not sweeping clean is that the oil takes much longer to soak in, and any cart or foot passing over it picks up the oil and dust together, leaving the bare road surface underneath. The second result is the dust so left will, as the oil dries up gradually

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become a nuisance, whereas a good road swept clean will form little dust.

It is of the utmost importance to oil the side roads to a distance of fully 100 yards from their junction with the road which is being oiled, as otherwise much dust is brought in on to the main road which destroys the effect of the oiling.

The first coat of oil soaks in rapidly if the surface is good, and in many cases traffic may safely be allowed over the road after three or four hours. Subsequent coats require very much more time. The oil soaks in slowly, and as it dries becomes exceedingly sticky; finally part of it soaks in and the rest dries and forms an asphaltic layer on the road.

Traffic going over the tough surface so formed merely polishes it, making it black and shiny, and causing but little wear. If traffic is allowed over the oil before it has dried a large portion of the oil is carried away on the mudguards, and the rest forms, with whatever dust there may be, a thick black mud. As it dries this mud turns into a paste which does not adhere to the wheels of vehicles, and is gradually rolled by them into the road forming a good surface, smooth and black. This paste however is not truly incorporated with the road, and as it gets drier it blisters and flakes away leaving the road covered with a soft oil-impregnated covering which in a comparatively short time, is pounded up into heavy dust.

9. Nearly all the Durbar Roads oiled were of this type, as the three days' rain which occurred in the middle of November, when most of the main roads had received their second coat, made it necessary to give another coat at a time when traffic was so heavy that it was quite impossible to close the main roads. Ridge and Flagstaff Roads alone showed the results which might be expected under normal conditions, and these remained nearly as good as ever after four months light wear.

It must be remembered that the oiling at Delhi was carried out under very severe conditions. In many cases roads could not be closed, and being done by halves it was quite impracticable to barrier off the road for perhaps a mile or more, so that traffic could not be kept off the newly-oiled road, particularly at night. Even where a road could be closed by day it was impracticable to erect permanent barriers, and temporary ones even with chowkidars proved quite useless after the Police had gone off duty, which happened at 8 p.m.

Traffic going over a road on which the oil had reached the sticky stage had another and sometimes a most serious effect. It tended to pick out lumps of kunkar in some cases leaving the road in a deplorable state, honeycombed with holes or lined with deep ruts. This tendency showed itself very greatly on one or two pieces of recently-made stone roads which were oiled, and where the consolidation had not set as well as in the case of a kunkar road.

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10. Oiling appears to be attended with one great disadvantage, it cannot stand heavy rain and traffic combined, as the road then becomes covered with a thick glue like mud, and loses a large portion of its oil which appears to be ground out by the rain. The effect of the heavy rain experienced at Delhi in the middle of November went particularly to destroy the effect of the second coat of oil on all the main roads. The Chauburja Road alone showed comparatively little damage, while the Ridge Road, on which traffic was light, appeared quite unaffected, by reason that these roads were built on a rock foundation and being also undulating and well drained the water ran off quickly, whereas many of the main roads became flooded and water-logged.

In addition to the metalled portion of roads many roads had "Katcha" sides which were also oiled. In this case no sweeping was done, the oil was merely spread thickly over the dust and natural earth, and allowed to soak in and be incorporated by traffic. This method is very expensive in oil but proved perfectly effective, a second coat of oil being rarely required. The object was merely to lay the dust with a very slowly evaporating substance instead of with one which evaporates quickly, as water does, but in many cases the oil had distinctly consolidating effect, and thus added to the travelling width of the road.

It should be noted that the ground must be absolutely dry before any oil is put on. The great advantage of oiling the unmetalled roadsides is that there is no dust, which ordinarily lies there, to get blown on to the oiled surface, or conveyed into it by wheeled or foot traffic, and spoil the effects of the oiling by lying over it; and it is greatly due to this precaution that in a windy dusty place like Delhi the road surfaces remained clean.

Oiling was also found most useful on the raised side walks which were made of rammed earth and giving a covering coat of oil, which not only consolidated them and effectually laid the dust, but made a pavement preferred by the natives walking over it in bare feet.

Oil was also laid on the track of the Durbar Light Railway with excellent results, as in spite of open carriages with low wheels, and a continuous service of trains, there was no dust on the line.

11. The advantages of an asphalte basis road oil claimed by the Asiatic Petroleum Company for their liquid fuel were fully established, and the results obtained gave great credit to this firm whose total output for the road work alone amounted to 1,414 tons, or about 3,33,610 gallons of oil.

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SIEGES AND THE DEFENCE OF FORTIFIED PLACES BY THE BRITISH AND INDIAN ARMIES IN THE XIXth CENTURY.

(Continued).

By COLONEL SIR EDWARD T. THACKERAY, V.C., K.C.B. (LATE R.E.).

THE SIEGE OF BURGOS, *September*, 1812.

Early in September, 1812, Wellington, desirous of sheltering his troops from the extreme heat, had sent four divisions and the cavalry to the Escurial and to St. Ildefonso, whence they could join Hill by the Valley of the Tagus, or Clinton by Arevolo. When, however, he learnt that King Joseph had decided to retreat upon Valencia, that Soult had abandoned Cordova and that Clinton was falling back before Clausel, he ordered the 1st, 5th, and 7th Divisions, Pack's and Bradford's Portuguese brigades, Ponsonby's light horsemen and the heavy German cavalry, to move rapidly on Arevolo, and on the 1st of September he quitted Madrid himself to take command. Yet his army had been so diminished by sickness that only 21,000 men, including 3,000 cavalry, were assembled in Arevolo. He could scarcely feed the Portuguese soldiers, who were also very ill-equipped, and their Government failed in transmitting either money or stores.

On the 4th, the Allies quitted Arevolo, on the 7th they entered Valladolid, and the Gallicians, who had returned to the Esla when Foy retreated, were ordered to join the Portuguese Army.

But the Gallicians did not obey the order, and the French retreated slowly up the beautiful Pisuerga and Arlanzan Valleys, which, in spite of the stories about French devastation, were carefully cultivated and filled to repletion with corn, wine, and oil. Nor were they deficient in military strength. Off the high road, on both sides, ditches and rivulets impeded the troops, while cross ridges continually furnished strong parallel positions flanked by the lofty hills on either side. In these valleys Clausel baffled his great adversary in the most surprising manner. Each day he offered battle, yet on ground which Wellington was unwilling to assail in front, partly because he momentarily expected the Gallicians to join him, but chiefly because of the steady decrease of his own army from sickness, which, combined with the hope of ulterior operations in the south, made him unwilling to lose men. By flank movements he dislodged the enemy, yet darkness fell each day ere they were completed and the morning

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sun always saw Clausel again in position. At Cigales and Dueñas in the Pisuerga Valley, at Pampliega in the Valley of the Arlanzan and at other places the French general offered battle, until he finally covered Burgos on the 16th by taking the strong position of Cellada del Camino.

But 11,000 Spanish infantry, 300 cavalry and 8 guns had now joined the Allies, and Wellington would have attacked on the 17th had not Clausel, able, wary, and skilful, observed the increased numbers and retired in the night to Frandovinez. His rear guard was, however, pushed sharply back next day to the heights of Burgos, and during the following night he passed through that town leaving behind him large stores of grain. Caffarelli, who had come down to place the Castle of Burgos in a state of defence, now joined him, and the two generals retreated upon Briviesca, where they were immediately reinforced by that reserve which the Emperor, with such an extraordinary foresight, had directed to be assembled and exercised in the Pyrenees in anticipation of Marmont's disaster. The Allies entered Burgos amidst great confusion, for the garrison of the castle had set fire to some houses impeding the defence of the fortress, the conflagration spread widely, and the partidas—who were already gathered like wolves round a carcass—entered the town for mischief. Mr. Sydenham, an eye-witness and not unused to scenes of war, thus describes their proceedings, "What with the flames and the plundering of the guerillas, who are as bad as the Tartars and Cossacks, I was afraid Burgos would be entirely destroyed, but order was at length restored by the manful exertions of Don Miguel Alava."

SIEGE OF THE CASTLE OF BURGOS.

Caffarelli had placed 1,800 infantry besides artillery men in the castle, and the Governor, Dubreton, was of such courage and skill that he surpassed even the hopes of his sanguine and warlike countrymen. The castle and its works enclosed a rugged hill, and between it and the river the city of Burgos was situated. An old wall with a new parallel and flanks constructed by the French, offered the first line of defence; the second line was an earthwork of the nature of a field retrenchment and was well palisaded; the third line was similarly constructed and contained the two highest points of the hill, on one of which was an entrenched building called the White Church, and on the other the ancient keep of the castle; this last was the highest point, entrenched and mounted with a heavy casemated work called the Napoleon Battery. Thus there were five separate enclosures, and the Napoleon Battery commanded everything around it save to the north where, at a distance of 300 yards, there was a second height scarcely less elevated than that of the fortress. This point, called the Hill of San Michael, was defended by a large horn-work

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with a sloping scarp 45 ft. high, and a counterscarp not less than 10 ft. high; it was unfinished and only closed by strong palisades, but it was under the fire of the Napoleon Battery, was well flanked by the castle defences, and covered in front by slight entrenchments for the out piquets. Nine heavy guns, eleven field pieces and six mortars or howitzers were mounted in the fortress, Clausel's reserve artillery and stores were also deposited there, and the armament could therefore be increased.

First Assault.

All the bridges and fords over the Arlanzan were commanded by the batteries, and two days elapsed ere the Allies could cross; but on the 19th, the passage of the rivers being effected above the town by the 1st Division, Major Somers Cocks, supported by Pack's Portuguese, drove in the French outposts on the Hill of San Michael. During the night the same troops, reinforced by the 42nd Regiment, stormed the horn-work after a murderous conflict. The Highlanders who bore the ladders under the command of the Engineer Pitt placed them very well, splicing them together to meet the great height of the scarp, yet the stormers were beaten back with great loss, and would have failed if the gallant Cocks with the 79th had not forced an entrance by the gorge.. The garrison was thus cut off and must have surrendered if Cocks had been well supported, but he was only followed by the 2nd Battalion of the 42nd, and the French being still 500 broke through and escaped. The affair was censured, the troops complained of each other, and the loss was above 400, whilst that of the enemy did not exceed 150.

Wellington was now able to examine the defences of the castle. He found them feeble and incomplete, and yet his means were so scanty that he relied more upon the enemy's weakness than upon his own power; for it was said that the garrison wanted water, and that their provision magazines could be burned. Upon this information he adopted the following plan of attack:—

Twelve thousand men composing the 1st and 9th Divisions and the two Portuguese brigades were to undertake the works; the rest of the troops, 20,000 exclusive of the partidas, were to form the covering army. The trenches were to be opened from the suburb of San Pedro, and a parallel formed in the direction of the Hill of San Michael. A battery for five guns was to be established close to the right of the captured horn-work. A sap was to be pushed from the parallel or as near to the first wall as possible without being seen into from the upper works, and from this point the Engineer was to proceed by gallery and mine.

When the first mine was completed, the battery on the left of San Michael was to open against the second line of defence, and the assault was to be delivered against the first line. If a lodgment was

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formed the approaches were to be continued against the second line, and the battery in San Michael was to be turned against the third line in front of the White Church, as the defences there were exceedingly weak. Meanwhile a trench for musketry was to be dug along the brow of San Michael, and a concealed battery was to be prepared within the horn-work itself with a view to the final attack on the Napoleon Battery. Headquarters were fixed on Villa Tore. Colonel Burgoyne conducted the operations of the Engineers, and Major Dickson those of the artillery which consisted of three 18-pounders and the five iron 24-pound howitzers only, and it was on account of these slender means, rather than because of the weak defence of the fortress, that this line of attack was chosen.

When the horn-work fell a lodgment was commenced in the interior, and was continued vigorously, although under a destructive fire of grape and shells on the workmen who were digging the musketry trench in front of the first battery. On the 22nd the fire of the besieged was redoubled, but the besiegers worked with little loss and their musketry galled the enemy. During the night the first battery was armed with two 18-pounders and three howitzers, and the secret battery within the horn-work was commenced. Wellington, deviating from his first plan, then resolved to try an escalade against the first line of defence, and selected a point half-way between the suburb of San Pedro and the horn-work. At midnight 400 men provided with ladders marched from under the hill on which the horn-work stood, to the attack of the wall which was from 23 to 25 ft. high but had no flanks; this was the main column, and a Portuguese battalion was also assembled in the town of Burgos to make a combined flank attack on their side.

Second Assault.

The assault was commenced by the Portuguese but they were driven back by the fire of the common guard alone, and the principal escalading party, composed of detachments from different regiments under Major Lawrie, 79th Regiment, got into disorder in passing a hollow way 50 yards from the wall, and had no success. The ladders were indeed placed and the troops entered the ditch, but in a state of confusion; Lawrie was killed, the bravest soldiers who first mounted the ladders were bayoneted, and the ladders were reared and overturned several times; combustibles were also cast down in abundance, and the British, giving way, left half their number behind. The wounded were brought off next day under a truce, and it was said that the French found the plan of the siege upon the body of a dead officer; certain it is that this disastrous attack stimulated the enemy's courage and produced a bad effect on the Allies, some of whom had been also greatly dispirited by the previous assault on the horn-work.

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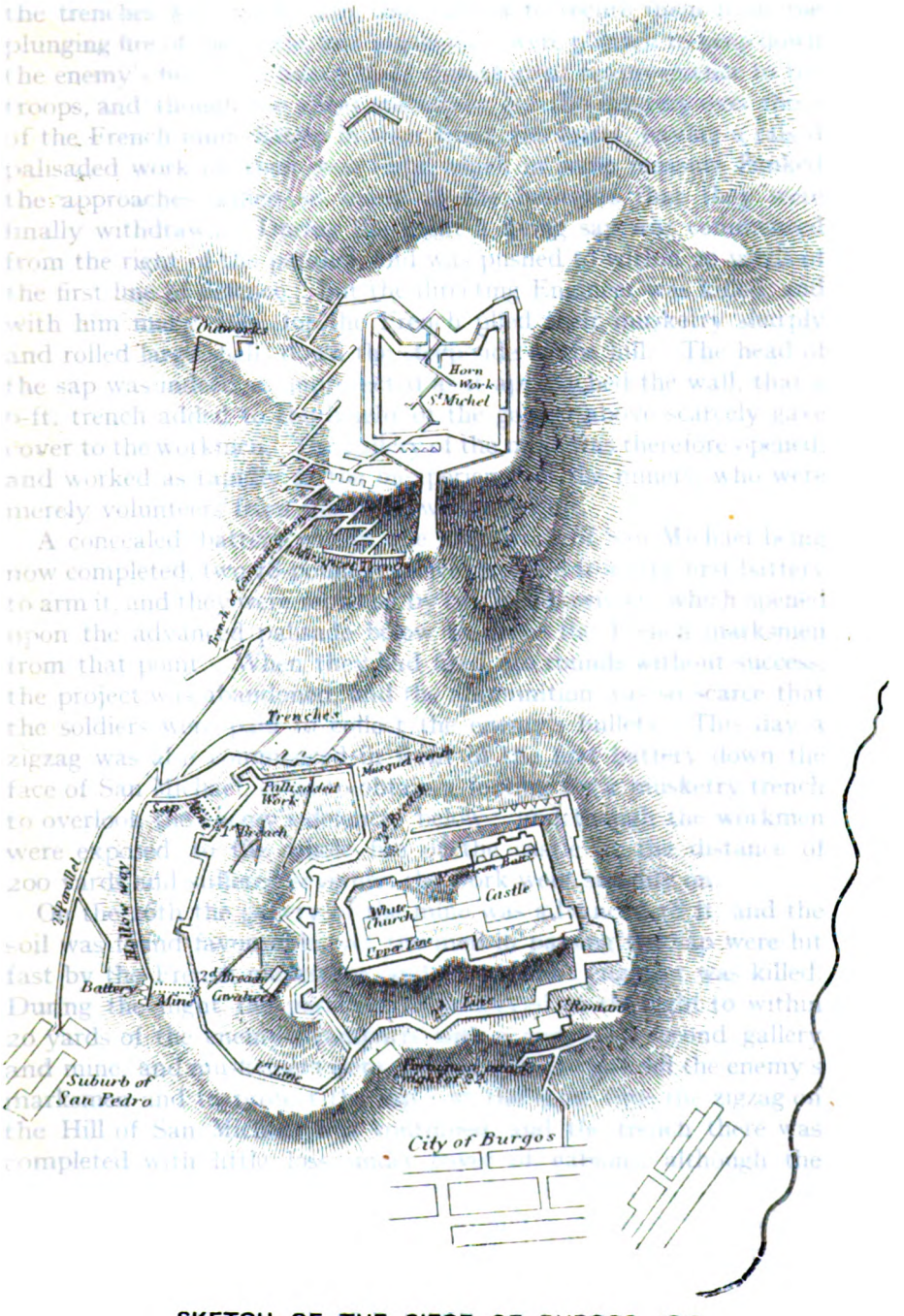

SKETCH OF THE SIEGE OF BURGOS, 1812.

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The hollow way which had led to the disorder amongst the escaladers, and which at 50 yards' distance ran along the front of defence, was converted into a parallel and connected with the suburb of San Pedro; the trenches were made deep and narrow to secure them from the plunging fire of the castle, and musketeers were planted to keep down the enemy's fire; but heavy rains caused great inconvenience to the troops, and, though the allied marksmen got the mastery over those of the French immediately in their front, the latter, having a raised palisaded work on their own right which in some measure flanked the approaches, killed so many of the besiegers that they were finally withdrawn. During the night a flying sap was commenced from the right of the parallel, and was pushed to within 20 yards of the first line of defence; but the directing Engineer was killed, and with him many men, for the French plied their musketry sharply and rolled large shells down the steep side of the hill. The head of the sap was indeed so unprotected as it approached the wall, that a 6-ft. trench added to the height of the gabion above scarcely gave cover to the workmen. The gallery of the mine was therefore opened, and worked as rapidly as the inexperience of the miners, who were merely volunteers from the Line, would permit.

A concealed battery within the horn-work of San Michael being now completed, two 18-pounders were removed from the first battery to arm it, and they were replaced by two iron howitzers which opened upon the advanced palisade below to drive the French marksmen from that point. When they had fired 140 rounds without success, the project was abandoned, and the ammunition was so scarce that the soldiers were paid to collect the enemy's bullets. This day a zigzag was also commenced in front of the first battery down the face of San Michael, so as to obtain a footing for a musketry trench to overlook the enemy's defences below; and though the workmen were exposed to the whole fire of the castle at the distance of 200 yards and suffered severely, the work went steadily on.

On the 26th the gallery of the mine was advanced 18 ft. and the soil was found favourable, yet the men in passing the sap were hit fast by the French marksmen, and an assistant engineer was killed. During the night the parallel was prolonged on the right to within 20 yards of the enemy's ramparts with a view to a second gallery and mine, and musketeers were planted there to pick off the enemy's marksmen and to protect the sap; at the same time the zigzag on the Hill of San Michael was continued, and the trench there was completed with little loss under cover of gabions, although the whole fire of the castle was concentrated on the spot.

On the 27th the French were seen strengthening their second line, and they had already cut a step along the edge of the counterscarp for a covered way, and had palisaded the communication. The besiegers likewise finished the musketry trench on the right of their

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parallel and opened the gallery for the second time. But the first mine went on slowly and the men in the sap were galled by stones, grenades, and small shells which the French threw into the trenches by hand; the artillery fire also knocked over the gabions of the musketry trench on San Michael so fast that the troops were withdrawn during the day.

During the night a trench of communication, forming a second parallel behind the first, was begun and nearly completed from the Hill of San Michael towards the suburb of San Pedro, and the musketry trench on the hill was deepened. Next day an attempt was made to perfect this new parallel of communication, but the French fire became heavy, and the shells which passed over came rolling down the hill again into the trench, so that the work was deferred until night and was then perfected. The rolling back of the shells continued to gall the troops, yet the whole of the trench was filled with men whose fire was incessant. The first mine was now loaded with more than a thousand pounds weight of powder, the gallery strongly tamped for 15 ft. with bags of clay and all was ready for the explosion and Wellington ordered the third assault.

Third Assault.

At midnight the hollow road 50 yards from the mine was lined with troops to fire on the defences, and 300 stormers were assembled there attended by others who carried tools and materials to secure the lodgment when the breach should be carried. The mine was then exploded, the wall fell and an officer with 20 men rushed forward to the assault. The explosion was not so efficacious as it ought to have been, yet it brought the wall down, the enemy was stupefied, and the Forlorn Hope consisting of a sergeant and four daring soldiers, gained the summit of the breach and stood there until the French, recovering from their panic, drove them back again pierced with bayonet wounds. Meanwhile the officer and 20 men, who were to have been followed by a party of 50 and these by the remainder of the stormers, missed the breach in the dark and finding the wall unbroken retired and reported that there was no breach; the main body immediately regained the trenches, and before the sergeant and his men returned with streaming wounds to tell their tale, the enemy was reinforced. Scarcity of ammunition stopped the artillery practice against the breach during the night and the French raised a parapet behind it, placing obstacles sufficient to deter the besiegers from renewing the assault at daylight.

This failure arose from the darkness and the want of a conducting engineer; out of four regular officers of that branch engaged in the siege, one had been killed, one badly wounded, and one was sick; the fourth was therefore necessarily reserved for the carrying on the works. The aspect of affairs was gloomy. Twelve days had elapsed

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since the siege commenced, one assault had succeeded, two had failed; 1,200 men had been killed or wounded, little progress had been made, and the troops generally showed symptoms of despondency—especially the Portuguese who seemed to be losing their ancient spirit. Discipline was relaxed, the soldiers wasted ammunition; the work in the trenches was avoided or neglected both by officers and men; insubordination was gaining ground, and reproachful orders were issued, the guards only being noticed as presenting an honourable exception. In this state it was essential to make some change in the operations, and as the French marksmen in the palisaded work below were now so expert as to hit everything seen, the howitzer battery on San Michael was reinforced by a French 8-pounder, and this mischievous post was at last demolished. The gallery of the second mine was also pushed forward, and a new breaching battery for three guns was constructed behind it, so close to the enemy's defences that the latter screened the work from the artillery fire of their upper fortress. But the parapet of the battery was only made musket-proof, because the besieged had no guns on the lower line of this front. In the night the three 18-pounders were brought from the Hill of San Michael without being discovered, and although a very galling fire of muskets hampered the workmen, they persevered until 9 o'clock, when the battery was finished and armed. But at that moment, the watchful Dubreton brought a howitzer down from the upper works and with a low charge threw shells into the battery; then making a hole through a flank wall he threw out a light gun which sent its bullets whizzing through the thin parapet at every round, and at the same time his marksmen plied their shot so sharply that the Allies were driven from their pieces without firing. More French cannon being now brought from the upper works, the defences of the battery were quite demolished, two of the gun carriages were disabled, a trunnion was knocked off one of the 18-pounders, and the muzzle of another was split. It was in vain that the besiegers' marksmen, aided by some officers who considered themselves good shots, endeavoured to quell the enemy's fire; the French being on a height were too well covered and remained masters of the fight.

During the night a second and more solid battery was formed a little to the left of the ruined one, but the French observed it at daylight, and their fire plunging from above knocked down the parapet so rapidly that it was relinquished. Recourse was then again had to the galleries and mine and to the breaching battery on the Hill of San Michael; the two serviceable guns were therefore removed towards the upper battery to beat down a retrenchment formed by the French behind the old breach. It was intended to place them upon this new position during the night of the 3rd, but the weather was very wet and stormy, and the workmen, those of the guards only excepted,

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abandoned the trenches; hence at daylight the guns were still short of their destination and nothing more could be done until the following night.

On the 4th, at 9 o'clock in the morning, the two 18-pounders and three iron howitzers again opened from San Michael's, and at 4 o'clock in the evening, the old breach being cleared of all incumbrances and the second mine strongly tamped for explosion, a double assault was ordered. The 2nd Battalion of the 24th British Regiment under Capt. Hedderwick was selected and formed up in the hollow way, having one advanced party under Lieut. Holmes pushed forward as close to the new mine as was safe, and a second party under Lieut. Fraser in like manner pushed towards the old breach.

Fourth Assault.

At 5 o'clock the mine was exploded with a terrific effect, blowing many of the French into the air and breaking down 100 ft. of the wall; the next instant Holmes and his brave men rushed through the smoke and crumbling ruins, and Fraser quickly fought his way on to the summit of the old breach; opposed with spears he was seen to tear one from the hands of an enemy and to leap into the midst of the hostile mass followed by his men. The supports followed closely and both breaches were carried with loss to the assailants of 37 killed and 200 wounded, seven of the latter being officers and amongst them the Commanding Engineer. During the night lodgments were formed in advance of the old, and on the ruins of the new breach, yet very imperfectly and under a destructive fire from the upper defences. This happy attack revived the spirits of the army, vessels with powder were coming coastwise from Corunna, a convoy was expected by land from Ciudad Rodrigo, a supply of ammunition sent by land by Sir Horne Popham reached the camp, the howitzers continued to knock away the palisades in the ditch, and the battery on San Michael's was directed to open a third breach, at a point where the first line of defence was joined by the second.

This promising state of affairs was of short duration.

On the 5th, at 5 o'clock in the evening, while the working parties were extending the lodgments, 300 French came swiftly down the hill and sweeping away the labourers and guards from the trenches, killed or wounded 150 men, got possession of the old breach, destroyed the works and carried off all the tools. During the night the Allies repaired the damage and pushed saps from each flank, to meet in the centre near the French line and serve as a parallel to check future sallies; the howitzers also continued their fire from San Michael against the palisades, and the breaching in the horn-work opened, but the guns being unable to see the walls sufficiently low down soon ceased to speak, and the embrasures were masked. On the other hand the besieged were unable, from the steepness of the castle hill, to depress

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their guns sufficiently to bear on the lodgment of the breaches in the first line, but their musketry was destructive, and they rolled down large shells to retard the approaches towards the second line.

On the 7th the besiegers got so close to the wall below that the howitzers above could no longer play without danger to the workmen, wherefore two French pieces taken in the horn-work were substituted and did good service. The breaching battery on San Michael's being altered also renewed its fire, and at 5 o'clock had broken 50 ft. off the parapet of the second line, yet the enemy's return was heavy and another 18-pounder lost a trunnion. During the night block carriages with supports for the broken trunnions were provided, and the disabled guns were enabled to recommence their fire with low charges. A constant rain now filled the trenches, the communications were injured, the workmen negligent, the approaches to the second line went on slowly, and again Dubreton came thundering down from the upper ground driving the guards and workmen from the new parallel at the lodgments, levelling all the works, carrying off all the tools, and killing or wounding 200 men. Colonel Cocks, promoted for his gallant conduct at the storming of San Michael, restored the fight and repulsed the French, but fell dead on the ground he had recovered.

After this severe check the approaches to the second line were abandoned and the trenches were extended so as to embrace the whole of the fronts attacked. The battery on San Michael had meantime formed a practicable breach 25 ft. wide, and the parallel at the old breach of the first line was prolonged by zigzags on the left towards this new breach, while a trench was opened to enable marksmen to fire upon the latter at 30 yards distant. Nevertheless another assault could not be risked, because the great expenditure of powder had again exhausted the magazines, and without a new supply the troops might have found themselves without ammunition in front of the French Army which was now gathering head near Briviesca. Heated shot were, however, thrown at the White Church with a view to burn the magazines; and the miners were directed to drive a gallery on the other side of the castle against the church of San Roman, which was pushed out a little beyond the French external line of defence on the side of the city.

On the 10th when the besiegers' ammunition was nearly all gone, a fresh supply arrived from Santander, but no effect had been produced upon the White Church and Dubreton had strengthened his works to meet the assault; he had also isolated the new breach on one flank by a strong stockade extending at right angles from the second to the third line of defence.

The fire from the Napoleon Battery had compelled the besiegers again to withdraw their battering guns within the horn-work, but the attempt to burn the White Church was relinquished, although the

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gallery against San Roman was continued. In this state things remained for several days with little change, save that the French, in spite of the musketry from the nearest zigzag trench, had scarped 8 ft. at the top of the new breach and formed a small trench at the back of it.

On the 15th the battery in the horn-work was again armed, and the guns pointed to reach the wall of the Napoleon Battery; they were, however, overmatched and silenced in three-quarters of an hour and the embrasures were once more altered so that the guns might bear on the breach in the second line. Some slight works and counter-works were also made on different points, the besiegers being principally occupied repairing the mischief done by the rain, and pushing the gallery under San Roman, where the French were now distinctly heard talking in the church; the mine was therefore formed and loaded with 900 lbs. of powder.

On the 17th the battery of the horn-work was renewed, the fire of the 18-pounders cleared away the enemy's temporary defences at the breach, the howitzers damaged the rampart on each side, and a small mine was sprung on the extreme right of the lower parallel, with a view to take possession of a cavalier or mound which the French had raised there, and from which they had killed many men in the trenches; it was successful and a lodgment was effected, yet the enemy returned in force and compelled the besiegers to abandon it again. On the 18th the new breach was rendered practicable and Wellington ordered it to be stormed. The explosion of the mine under San Roman was to be the signal, the church was also to be assaulted, and at the same time a third detachment was to escalade the works in front of the ancient breach and thus connect the attacks.

Fifth Assault.

At 4.30 the springing of the mine at San Roman broke down a terrace in front of that building, yet with little injury to the church itself; the latter, however, was resolutely attacked by Colonel Browne at the head of some Spanish and Portuguese troops, and though the enemy sprung a countermine which brought the building down, the assailants lodged themselves in the ruins. Meanwhile 200 of the foot guards with strong supports poured through the old breach in the first line and escaladed the second line, beyond which in the open ground between the second and third lines, they were encountered by the French, and a sharp musketry fight commenced. At the same time a like number of the German legion under Major Wurmb, similarly supported, stormed the new breach on the left of the guards so vigorously that it was carried in a moment, and some men mounted the hill above and actually gained the third line. Unhappily at neither of these assaults did the supports follow closely, the Germans, cramped on their left by the enemy's stockade, extended their right

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towards the guards, and at that moment Dubreton came dashing like a torrent from the upper ground and quickly cleared the breaches. Wurmb and many other brave men fell, and the French gathering round the guards who were still unsupported, forced them beyond the outer line; more than 1,000 men and officers were killed or wounded in this combat, and the next night the enemy recovered San Roman by a sally.

The siege was thus virtually abandoned. The French were indeed beaten out of San Roman again, and a gallery was opened from that church against the second line; but these were mere demonstrations, and the contemporary events which compelled a victorious army to abandon the siege of a small fortress, strong in nothing but the skill and bravery of the Governor and his gallant soldiers, need not be related in this work which is occupied only with the siege of the place.

So vast and intricate an art is war, that the apothegm of Turenne will always be found applicable: "he who has made no mistakes in war, has seldom made war." Some military writers, amongst them the celebrated Jomini, blame the English general because, with a conquering army and an insurgent nation at his back, he, during the three months after his victory at Salamanca, attempted nothing more than the unsuccessful Siege of Burgos. This censure is not entirely unfounded and the King certainly escaped very easily from Madrid; yet there are many points to be argued ere the question can be decided. The want of money, progressively increasing, had become almost intolerable. The army was partly fed from Rodrigo, partly from the Valley of the Pisuerga; Hill's troops were fed from Lisbon; the Portuguese from their own country; the Spaniards always lived like the French by requisition; the British professed to avoid that mode, and their movements were therefore subservient to this principle and must be judged accordingly; want of money was want of motion.

The objection may be more that, as Burgos did not yield, it would not have yielded under any circumstances without a vigorous defence. This is not so certain; the prolonged defence of the castle was due to some errors of detail in the attack as well as to want of sufficient artillery means. In respect of the great features of the campaign, it may be assumed that Wellington's judgment on the spot and with a full knowledge both of his own and his adversary's situation, is of more weight than Jomini's, however able and acute, for he knew nothing of the difficulties.

It is said Sir Howard Douglas, on being consulted, objected to the proceeding by gallery and mine against an outward, a middle, and an inward line of defence, as likely to involve a succession of

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tedious and difficult enterprises, which even if successful would still leave the White Church and the castle to be carried; that this castle, besides other artillery armament, was surmounted by a powerful battery of heavy guns, bearing directly upon the face of the horn-work of San Michael, the only point from which it could be breached, and until it was breached the Governor, a gallant man, would certainly not surrender. It could not, however, be breached without a larger battering train than the Allies possessed, and would not as he supposed be effected by mines; wherefore, proposing to take the guns from two frigates then lying at Santander, he proffered to bring them up in time. In this reasoning Wellington partly acquiesced, but he expected success from the scarcity of water in the castle and the facility of burning the provision magazines; he also trusted to good fortune. Towards the end of the siege, however, and too late, he got the guns from Santander.

(To be continued).

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TRANSCRIPT.

THE SIEGE OF ADRIANOPLE.

From an article by V. N. POLYANSKI in the September, 1913, and subsequent numbers of *Injenerni Jurnal.*

(*Continued*).

CHAPTER III.—*Continued.*

The Blockade of the Fortress.

At the time when the Bulgarians were drawing up their plan of campaign they did not anticipate a protracted struggle. They expected that a general action would certainly take place in the neighbourhood of Adrianople, and that in it the Turks would be so badly beaten that their government would find it necessary to sue for peace.

There is ground for the supposition that the capture of Adrianople did not enter into the initial plan of the Bulgarian politicians, as it was probable that Russian diplomacy would be opposed to this, seeing that Adrianople is the " Key to Constantinople " and consequently also to the Straits. This key it would be wiser to leave for the time being in the weak hands of the Turks, than in the strong and tenacious hands of a young nation.

The Bulgarians had calculated to conclude the campaign in the course of six weeks, and under such considerations it would undoubtedly have been unwise to attempt to take Adrianople by assault. It was sufficient to be content to blockade it, and so to paralyze its action.

When the Turkish Army fell back and was still capable of resistance, it became necessary to reinforce the Ist and IIIrd Armies. With this object a part of the regular troops of the IInd Army were transferred to the field operations, and their place was taken by Bulgarian reserves and by two Servian divisions which were available after the Battle of Kumanov.

After the Battle of Lozengrad, the 8th and 9th Infantry Divisions remained for some days entrenching the positions which they had occupied :—The 8th Division held the West Front, on the line of the village Yurush, and the 9th the North-West Front, on the line of the villages Kemal—Ak-Bunar. On the 27th October the relief took place. The 11th Infantry Reserve Division arrived and was placed on the North-West Front, together with the 2nd Brigade, 9th Division. Two brigades of the 9th Division crossed to the left bank of the Tunja and prolonged the line of investment on the North-East Front, and the 2nd Brigade, 8th Division, were also allotted to this section. On the West Front there remained two brigades of the 8th Division, to which was added the 1st Brigade, 2nd Division (Trakis), which came from Kirjali (the so-called " Haskovo Detachment ").

After three or four days a fresh re-allotment of units took place, as the 2nd Brigade, 9th Division, and the " Haskovo Detachment " were sent to the coast of the Sea of Marmora to reinforce the Ist Army.

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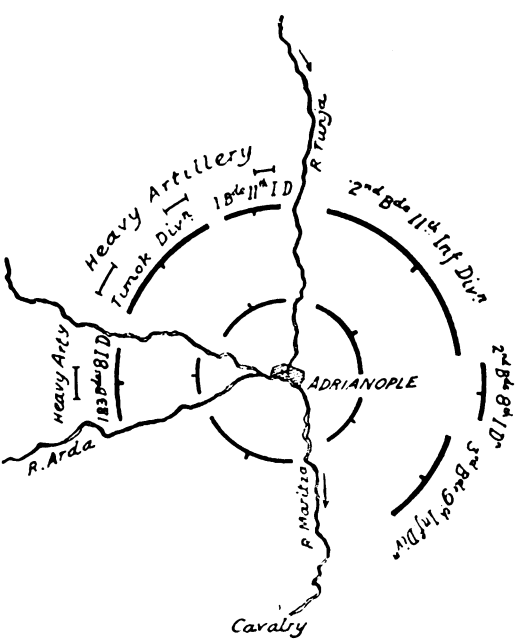
In spite of these frequent reliefs of the units of the siege army, which were continually on the move *across the front* of the fortress positions, the garrison made no use of these favourable opportunities, and not once did they attempt to attack the troops in the course of their march. Only small sorties were undertaken by weak detachments, probably for reconnaissance, but they did not discover the reliefs of the troops. The absence in the fortress of means of aerial reconnaissance was clearly evident, as such reconnaissance would have undoubtedly revealed the movement of these large columns.

On the 29th October the Sofia and Shumla Fortress Battalions arrived by rail at Mustapha-Pasha with the heavy (siege and fortress) artillery, which was transferred by means of bullocks to the North-West Sector.

On the 30th the town of Dimotika was taken and the communication between Adrianople and Constantinople was cut. On the 1st November there arrived the Servian Timok Division of the first call (less one regiment), and once more the units of the siege army began to move round and to relieve one another. The Servian Division, with the 1st Brigade, 11th Bulgarian Division, occupied the North-West Sector; the rest of the 11th Division, and one brigade of the 8th and one of the 9th Division, occupied the North-East Front; the 1st and 3rd Brigades, 8th Division, remained in the West Sector. The Bulgarian Life Guards Cavalry Regiment and the Servian Timok Cavalry Regiment were placed under the command of the commandant of the North-East Front, with the object of observing the valley of the Maritza and preventing the garrison from sending out foraging parties to the south (see Plan No. 2).



PLAN NO. 2.—*Distribution of Siege Army on 5th November.*

The closing in of the investment line was carried forward gradually, but it was not completed until the 12th November, as this was not

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possible until after the attacks on the Turkish advanced positions on the South Front, and until the arrival of the Servian Danube Division of the second call, for the occupation of the West Front, in the place of the 8th Infantry Division, which enabled the latter to move on to the South Sector and to close the ring of investment. Before proceeding with the description of these events it is proposed to give an accurate description of the positions of investment of the Allies, as they existed on the 5th November, on which date the moving of troops and the posting of the heavy artillery were completed and it became possible to proceed to active measures.

As it was at first intended to be content with a simple blockade of the fortress, and in order that the blockading troops should not be exposed to unnecessary losses, these positions were selected *at the full range of effective fire of the fortress artillery*. The ground had already been reconnoitred in peace-time, and the sites for strong points had been marked by red crosses on the map, so that the troops had only to occupy positions already decided upon.

In the *West Sector*, opposite the Papas-Tepe Group, the 1st and 3rd Brigades, 8th Tunja Infantry Division, were posted. After the fighting of the 21st October parties of this division were entrenched about the village Yurush. A redoubt and some trenches were made on the high ground lying immediately to the east of the village, while the main position of the attack was on a ridge about 2 kilometres* to the east of Yurush.

The line was fortified by rifle trenches, with trenches for reserves on the reverse slopes, and dug-outs at the foot of the slopes and in the ravines. The outposts lay a kilometre further east, in trenches, which were concealed by sections of portable tents.

In this sector the positions of the attack were within 2 kilometres of the front line of Turkish trenches, but this was admissible, as here the Turks had few guns of large calibre.

On the *North-West Sector* there were three regiments of the Servian Timok Division and one of the 11th Bulgarian Division. The second regiment of this division (55th) formed the reserve and was posted in the village of Visgach. The main positions of the attack were from 6 to 6½ kilometres from the Turkish works, and occupied the ridge lying on the east of the stream Kemal-Dere, from there to the village Kara-Bulut, the village Sarai-Ak-Bunar, and ended on the ridge south of the stream Bakhcha-Dere, on the bank of the Tunja.

The works had been begun by the Bulgarian 9th Infantry Division, and were afterwards developed and completed by the Servians. The section from the Maritza to Sarai-Ak-Bunar was held by the Servian Division (13th, 15th and 20th), and that from there to the Tunja by the 56th Bulgarian Regiment.

The fortification works consisted of a line of redoubts (at mutual distances apart of about a kilometre), of rifle trenches, communication trenches, dug-outs, shelters and batteries. The sections which were of greater tactical importance were fortified more strongly. Thus, for example, on the commanding ridge to the south-east of Kemal there was constructed a strong point for one battalion, consisting of two redoubts connected together by a rifle trench. On front and flanks the

* 1 kilometre = 1,093·6 yards.

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group was protected by a wire entanglement, and on the reverse slope there was a shelter for the men, with a communication to the right redoubt. Field batteries were also included in the organization of the group, and the village of Kemal was prepared as a keep to it.

In the centre of the Servian front there was a fortified group on the ridge lying south of Kara-Budut. As a strong point on the left flank there was a group on the hill called Taushan-Kula, consisting of a closed work on the hill Nairak-Tepe, a group of trenches on the hill Sinchu-Tepe, and, on a knoll in rear, a lunette sweeping with fire the interior of the strong point, besides several batteries. In front, to the south of Sarai-Ak-Bunar, there was a long trench connected with the village by a communication trench, and the outskirts of the village were also prepared for defence.

The high ground between the streams Bakhcha-Dere, Fishera-Dere and the unnamed one, formed the strong point of the 56th Bulgarian Regiment. This was fortified by a group of trenches and two half-closed works connected by trenches.

On the bank of the Tunja the position of the 56th Regiment broke back in a right angle towards the north, on the hills named Kuvan-Kaya, with a field of fire over the Tunja valley. This section was important when the Bulgarians had not yet occupied the positions on the North-East Front, and protected them against an attack on their flank from the Tunja valley.

The outposts of the North-West Sector lay about 2 kilometres in front of the main position, from the crest on the east of the farm Kara-Smailcha, but west of the farm Yekmekchi-Keui (which changed hands more than once, but remained in the possession of the Turks), eastwards to the high ground on the south of Sarai-Ak-Bunar. In front of the positions of the 56th Regiment, they occupied the heights of Eski-Injernik and the north side of the Mamun-Dere Ravine.

Behind the main front of the positions of investment there were made rear strong points at the villages Akhar-Keui and Visgach. To east of the last-named village, on Hill "230" there was a redoubt, in which a searchlight was installed, at 7 kilometres' distance from the Uch-Tepeler advanced position, and 9 from the Shaitan-Tarla Fort!

As to the details of the works on the West and North-West Sectors, the redoubts were all of trench profile with garrisons of from one-half to one company. In plan the redoubts were widely extended in breadth and compressed in depth. They had traverses, interior communications, casemates proof against splinters, and observation posts. They were surrounded by wire entanglements, but these were of very weak construction, the posts low and of wood, the wire plain and barbed.

On the flanks of the redoubts there were mounted machine guns, or q.f. 57-m.m. guns on Griuson armoured carriages, for repelling assaults.

The rifle trenches were of *full* profile (*i.e.* for firing, standing, from a step with passage in rear) with overhead cover, forming defensible blindages, or casemates, the materials for roofing being taken from the neighbouring villages, or even brought from Bulgaria, as there was no timber in the neighbourhood. Some narrow gauge rails which were laid along the Constantinople main road proved of very great use for the transport of engineer stores.

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The trenches, redoubts, wire entanglements, in fact all the works on the positions of investment, were very badly concealed. The dug-outs were narrow and without stoves, and sufficient attention had not been paid originally to drainage, and consequently the conditions of life in them were very hard, especially in winter, when snow fell. The men suffered from colds, typhoid and dysentery, and it was only due to their astonishing hardiness that their mortality did not reach menacing proportions.

On the *East* Front the 3rd Brigade, 9th Infantry Division, the 2nd Brigade, 8th Infantry Division, and the 2nd Brigade, 11th Infantry Division, occupied the investment line, and here also was the composite mounted brigade.

In this sector the main position of the Bulgarians was 6 to 7 kilometres from the Turkish forts, and ran from the heights of Bos-Tepe (south of the village of Murad-Chali), to Sofular, Hadir-Aga, Musubeili, from there to the crest of Sharap-Yolu, the heights west of the village Skender-Keui, and ended on the knolls of Kara-Bair, on both sides of the Constantinople high road.

The section from Bos-Tepe to the valley of the Provadiisca, at the village Hadir-Aga, was fortified by groups of rifle trenches. From the Provadiisca to the south there ran a line of redoubts spaced at intervals of 1 to 1½ kilometres from one another ; some of these were strengthened by wire entanglements, and between them there were made uninterrupted lines of rifle trench, with communication trenches to the rear. On the reverse slopes there were dug-outs and field batteries. The latter were sited from 150 to 200 paces behind the infantry, showing that the Bulgarians had no fear of premature bursts of shrapnel.

The rifle trenches were of various Russian types of profile, with traverses and light shrapnel-proof overhead cover, but there were no defensible casemates on this front. As the soil was clay it was possible to excavate " Boer " recesses in the front interior slopes of these trenches.

The trenches were sited chiefly on the military crests and their concealment was very unsatisfactory.

At 1½ kilometres in rear of the main positions, reserve rear positions were fortified, also with redoubts and rifle trenches. The outposts lay from 1½ to 2 kilometres to the west of the main positions.

The section of the East Sector lying between the Constantinople high road and the Maritza was picketed by the cavalry, who here constructed a row of separate troop trenches.

The heavy artillery on its arrival at Mustapha-Pasha, was immediately sent against the fortress and disposed in the following manner :—

On the West Sector, the Shumla Fortress Battalion, *nine* batteries :—

1 battery of 12-c.m. q.f. howitzers ..	..	4
2 batteries of 15-c.m. L/12 howitzers	..	8
2 ,, ,, 12-c.m. L/25 guns ..	..	6
2 ,, ,, 12-c.m. L/30 guns ..	..	6
2 ,, ,, 15-c.m. L/30 guns ..	..	6
	Total ..	30 guns

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The objective of the first (right-flank) battery was the village Chore-Keui (range 6,600 yards). That of the seven centre batteries was Papas-Tepe (range 5,500 yards). That of the left flank battery was the village Kadin-Keui (range 6,600 yards). Some of these batteries (12-c.m. L/30 and 15-c.m. L/30) could throw shells as far as Kartal-Tepe.

On the North-West Sector, the Sofia Fortress Battalion; divided into "heavy" and "light divisions."

The heavy siege division consisted of *seven* batteries:—

2 batteries of 15-c.m. L/30 guns	.. ..	8
2 ,, ,, 12-c.m. L/30 guns	.. ..	6
3 ,, ,, 12-c.m. L/28 guns	.. ..	12
	Total ..	26 guns.

This division was posted in one group, but in two lines, in lightly wooded ravines, on the south-west of the village Kemal, and at a distance of 1 kilometre from it. Of these batteries the 12-c.m. had as an objective the Papas-Tepe Group (range 7,700 yards), and the 15-c.m. had the fort Kazan-Tepe and the position in its neighbourhood (range 9,800 yards).

The light siege division consisted of *ten* batteries:—

3 batteries of 12-c.m. L/28 guns	.. ..	12
3 ,, ,, 15-c.m. L/12 howitzers	..	12
3 ,, ,, 12-c.m. L/12 howitzers	..	18
1 battery of 12-c.m. q.f. howitzers	.. ..	4
	Total ..	46 guns.

This division was posted in two groups:—The first, howitzers, in the area of Kara-Bulut, with objective the Shaitan-Tarla Group (range 7,100 yards).

The second, guns and howitzers, north and east of Sarai-Ak-Bunar, objectives Shaitan-Tarla and the Uch-Tepeler advanced position (ranges from 4,400 to 7,700 yards). Two batteries of this group could sweep with enfilade fire the works and trenches of the North-West Front.

All the heavy artillery was thus deployed on the West and North-West Fronts. Most of the guns stood *at extreme ranges*. All the batteries were *in concealed positions, skilfully applied to the ground and entrenched.*

The dug-out shelters of the batteries were of Russian types, but the gun portions were *obligatorily roofed with light shrapnel-proof head cover.* This was constructed in the following manner:—Four uprights were connected together by capsills, on which were fastened planks or poles, covered with zinc or iron sheets, so that the earth which was spread on the top, level with the traverses, should not drop down upon the guns. This head cover protected the gun crews from shrapnel, and concealed the batteries from observation from the captive balloon.

In some of the batteries instead of the uprights the roof covering rested on rails supported by the traverses. Niches were made in the traverses.

The men lived in the dug-outs which were made in rear or to one side of the batteries, with which they were connected by communication trenches. The embrasures were protected from oblique hits by special

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traverses in front. The type of the Bulgarian siege battery is shown in *Fig.* 3.

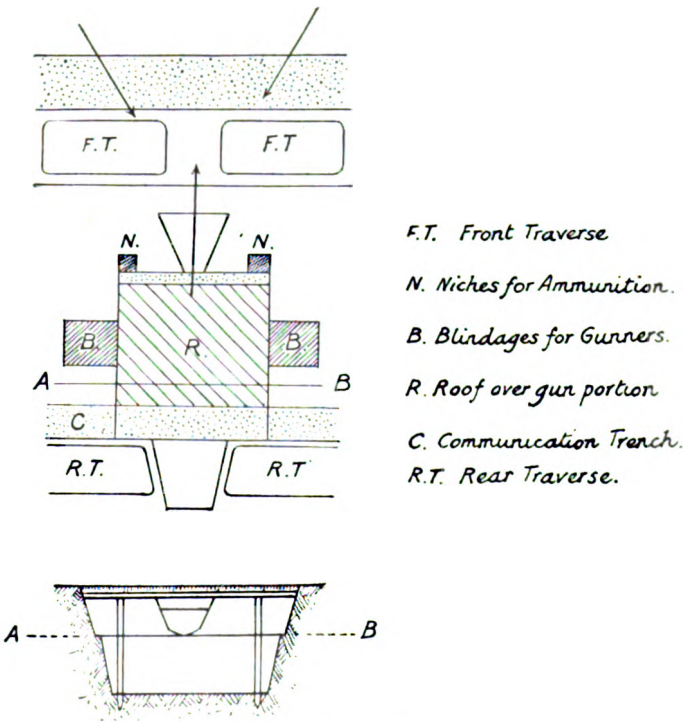

FIG. 3.—*Siege Battery.*

There were both battery and group observation stations, sited either in rifle trenches or separately, well concealed and blinded as a protection from shrapnel and splinters.

The organization of the supply of ammunition to the batteries. In the niches by the guns there was one day's supply, at the rate of 20 common and 60 shrapnel shells per gun. Near the batteries were *group* magazines, holding two days' supply for the groups. At 4 to 5 kilometres in rear of the artillery positions were the *sector* magazines, holding reserves of all military stores and equipment for three periods of twenty-four hours.

The waste from the niches was replaced from the group magazines by hand carriage. The transport from the sector magazines to the group magazines, and the supply of the former from Mustapha-Pasha were carried out by bullocks. The stores were brought to Mustapha-Pasha by rail.

Such was the position of the Allies up to the 6th November when the second Servian (Danube) Division had arrived and the deployment of the heavy artillery had been completed.

Only then was it possible to take active measures against the fortress, and the reproach brought against the Allies, that " they did not at once attempt to take the fortress by assault, on the first moonlight night "

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is unjust. An attempt to storm the fortress without the co-operation of heavy artillery, with relatively weak numbers, on the strongest fronts, might have ended very disastrously for the attack. The Bulgarian staff was too well trained in military matters to risk such an operation.

The choice of the positions of investment was tactically correct, as they corresponded with the objects assigned to them—a blockade with the lowest possible losses—but the character of the works, especially on the East Front does not merit imitation. It was not necessary to construct a continuous fence of redoubts and trenches, and it would have sufficed to apply the group system, in the manner of the Servian groups on the North-West Front. Greater attention should have been paid to technical details, and to the creation of more hygienic conditions for the accommodation of the men, who had to spend the winter in such rigorous circumstances. Better dug-out shelters should have been provided, and also better storm-water drainage. Latrines should have been made and even possibly baths, though the author admits that he has never seen these last provided in the positions of investment of a fortress. From the evidence of those who took part, at first no attention was paid to the construction of communication trenches, but the Turkish fire soon showed the necessity of these.

The *omission of concealment of the works* must be considered a grave defect, which enabled the Turkish artillery to locate accurately redoubts and trenches, and it was only due to the bad shooting of the Turks and the long range, that the troops on the positions of investment did not suffer heavy losses. The construction of the siege batteries with the blinded gun portions deserves attention, as it proved to be of enormous service.

Comparing the work of the Bulgarians and Servians, it must be admitted that the entrenchments of the Servians were more carefully finished, the interior slopes of parapets were revetted, the trenches better concealed and of more suitable types (low parapets, glacis-shaped profiles, trenches deeper and narrower).

The position of the heavy artillery, as regards general siting, was correct, for this simple reason, that rapid deployment—in four days—was possible only in the area nearest to the main road from Mustapha-Pasha to Adrianople, as the hauling of the guns, by bullocks, in the rainy season of the year, by the unmetalled roads leading to the South or East Fronts, would have required a great deal of time—as was made evident later on. The siting of the majority of the batteries at extreme ranges must be recognized as an error, as it made difficult the transference of fire to various targets on the hostile front. Under the conditions of the careful application of batteries to the ground, of blinded gun portions, and with good positions available at shorter ranges, the extreme distances of the Bulgarian batteries were inexplicable.

The direction of fire of all the siege artillery was *in the hands of the Commander of Artillery of the Siege Armies*, through the commanders of (artillery) regiments, and of groups. The batteries were connected together by a liberal network of telephones. With a view to the transference of fire, orders were issued to prepare subsidiary directing points, and if necessary to excavate spare batteries. The responsibility for the construction and arming of the batteries was placed upon the battery

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commanders, and labour and transport were allotted to them for this purpose.

The *action of the garrison* of the fortress during this period was beneath criticism. Not a single sortie was attempted with the object of interfering with the movements of the Allies across the front of their positions! At times the heavy artillery of the attack was left almost without escort, and might have fallen an easy prey to an enterprising garrison. It may be asked, if, failing active measures, the Turks were engaged in strongly entrenching themselves? This was by no means the case, as will be seen from the description of the fortress after its fall. All they did was to burn the village of Marash, within the fortress area, and put its Christian population to the sword. Most of their artillery was already in position, but they did at this time mount 72 howitzers on the North-West Front.

The Commencement of Active Operations.

Having completed the movements of troops on the line of investment, and having deployed their heavy artillery, the staff of the siege armies decided to proceed to active measures. Before all things it was necessary to capture the Kartal-Tepe Height, in order to close the line of investment and to obtain an observation point from which the whole of the town, the positions of the South Front, and the interior of the fortress area, could be seen:

But the transference of the Kartal-Tepe advanced position into the hands of the attackers would not have given them extraordinary advantages for attack, because firstly the distance (11,000 to 12,000 yards) was too great to allow of a bombardment of the town from this point, and chiefly it would have pointed to a purely passive decision "*to observe but not act*," as the neighbourhood of Kartal-Tepe was unsuitable for the deployment of heavy artillery, both on account of the long distance and because of the absence of good positions. In conjunction with this it was essential to attempt the capture of the Papas-Tepe fortified group, as there only there were to be found good artillery positions, from which to sweep with oblique fire the forts of the North-West Front, and to bombard the town; furthermore if this group were not taken it would be impossible to bring a decisive attack against the North West Front, as the approaches to the latter were enfiladed from Papas-Tepe.

Papas-Tepe had in addition great value as an observation post, incomparably superior to Kartal-Tepe, on account of its shorter distance from the centre of the fortress. It commanded a splendid view of the South Front, Karagach, the railway station, the city of Adrianople, the whole of North-West Sector with the ground in rear of it, and from it by telescope it was even possible to observe the rear of the East Front.

The military action of the Allies on the 6th and 7th November has often been described as a first attempt to capture the fortress by assault, ending in failure. But this is incorrect, as the Allies, after the capture of the Papas-Tepe Group, in order to take the fortress, would still have had to force the passage of the Maritza and the Arda, which were not fordable in the autumn. On the south side too, after the fall of Kartal-Tepe, they would have had to capture the forts and force the passage of the Maritza by the only existing stone bridge. From this it is plain

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that to secure the fall of the fortress it was necessary to capture the *East* or the *North-West* Front, of which the latter, as explained above, was impossible without the preliminary capture of Papas-Tepe.

As all the preparatory action of the Allies for the attack on the fortress had taken place on the North-West Front, the first problem confronting them was to secure for themselves the possibility of attacking this front, by the capture of Papas-Tepe.

The fighting on the 6th and 7th November, therefore, was not an assault on the fortress, but a preliminary to it. The attack on Kartal-Tepe was an action very characteristic of modern warfare, a *fight for an observation position.*

For the capture of these positions there were detailed the units of the 8th Bulgarian Division. One regiment and a q.f. division were ordered to cross to the right bank of the Arda, and, with the co-operation of the cavalry, to attack Kartal-Tepe, while the remainder of the division was to carry Papas-Tepe. The attacks were to be supported by the fire of field and heavy artillery.

The artillery objectives were assigned as follows :—

The Shumla Fortress Battalion was to act against Papas-Tepe, Bekchchi-Tepe and Kartal-Tepe. Total 30 guns. Of the Sofia Fortress Battalion, one battery, 12-c.m. L/28, was to act against the advanced trenches which lay 2 kilometres to the west of the summit of Papas-Tepe, and against the strong point ; the other 12-c.m. L/28 batteries, against the tomb which lay just west of Papas-Tepe ; two batteries 12-c.m. L/30 against Papas Tepe and Bekhchi-Tepe. Total 16 guns. Grand total of guns told off for fire upon the points of attack, 46.

The rest of the siege artillery guns, 56, were to fire on the batteries and works of the North-West Front, and to repulse sorties.

The field artillery was assigned as follows :—On the right bank of the Arda, opposite Kartal-Tepe, one q.f. division of the 8th Regiment (12 guns) ; on the West Front, two q.f. divisions of the 8th Regiment (24 guns) ; on the North-West Front, one q.f. division of the Timok Artillery Regiment (12 guns) at Kemal village. Total 48 q.f. guns.

For repulsing sorties there remained on the North-West Front :—

At Ak-Bunar, one q.f. division, Timok Artillery Regiment	12 guns
,, ,, 11th non-q.f. Artillery Regiment ..	24 ,,
To north of Kemal 9th Artillery non-q.f. Regiment ..	24 ,,
Total ..	60 guns.

One q.f. division of the Timok Artillery Regiment (12 guns) formed the artillery reserve.

Therefore, *for the attack*, there were detailed :—

Infantry		8 battalions
Siege guns		46
Field guns		48
For repulsing sorties :—		
Infantry.	On West Front	8 Bulgarian battalions
	On North-West	12 Servian battalions
	,, ,, ...	8 Bulgarian battalions
Artillery.	Siege guns	56
	Field guns	72

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This division of forces appears at first sight to be wrong, as a larger force was assigned to the passive task than to the attacks on the selected positions. But actually the attacks on Papas-Tepe and Kartal-Tepe formed only the *first task* which would have to be completed in connection with the proposed active measures against the fortress. As is seen from the subsequent orders of the siege army, immediately after the capture of these points it was intended to attack the North-West Sector. This is evident, for example, from Order No. 407 of 7th November (26th October O.S.), in which it was laid down that on the capture of Papas-Tepe and Kartal-Tepe the commander of the Timok Division was to seize Point 154 near the farm Yekmekchi-Keui.

If one studies the map the significance of this point will be recognized. It lies 2½ kilometres from the Shaitan-Tarla Group and commands all the surrounding ground; on its reverse slopes there are splendid artillery positions at decisive ranges; and here the infantry of the attack could be brought up without serious losses. It is plain that this hill forms a base of departure for the attack on Shaitan-Tarla, and it was necessary to capture it with this object.

Would it have been more correct if simultaneously with the attack on Papas-Tepe, they had attacked Point 154? Hardly so, since the attack on this hill would follow as a natural sequel to the fall of Papas-Tepe, which was the first condition of the possibility of active measures against the North-West Front.

Consequently it may be said that the *main object* of the staff of the siege armies was the attack on Shaitan-Tarla, and with this end it was necessary for them to complete the *first task* the capture of Papas-Tepe and the *second task* that of 154.

With this end in view they so distributed their forces that the larger part of the heavy artillery was directed against Shaitan-Tarla, but part of this was so posted that it could also act against Papas-Tepe. All the heavy guns deployed on the North-West Front could act against 154.

To concentrate *at first* the greater part of the artillery against Papas-Tepe and later to transfer it to another front was under existing conditions impracticable. For the success of the intended operation it was necessary, on the completion of the first task, immediately to follow it up, without allowing to the enemy time to organize measures of resistance. The manœuvring of heavy artillery with bullocks in the muddy ground would have taken so much time, that by the time it was completed the conditions would have changed to the disadvantage of the attack.

The grouping of the infantry was also arranged to conform with the intended operations. For the attack on Papas-Tepe *one* regiment was detailed; in reserve on the West Front there were *two* regiments. This would appear at first sight an unsound division, but for the fact that the Papas-Tepe Group was shaped like a wedge, narrowing towards the rear. At the widest part, where lay the first Turkish trenches, its width of front was about 1 kilometre, but at the summit it had narrowed down to ½ kilometre. It was impossible to deploy more than one regiment on such a front. It would have been a grave tactical error to mass the troops behind one another, and this the staff avoided, not

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following the letter of the regulations, but correctly appreciating the local conditions.

For the attack on Kartal-Tepe there were detailed a regiment of infantry and detachments of artillery and cavalry. As circumstances showed later this force was sufficient.

The greater part of the infantry of the North-West Sector were kept inactive, because it was intended that they should commence the attack on 154 and Shaitan-Tarla as soon as the success of the first attack should be known. When the main objective was disclosed by the staff of the siege armies, corresponding arrangements were ordered. Thus in the same order, No. 407, in which the attack on 154 was promulgated, it was detailed that the siege artillery must be moved nearer to the fortress positions, and the troops in other sectors must attack the enemy in order to make it impossible for help to be sent to the North-West Front; but that the troops who had taken the recently captured positions should entrench them. The attack on the main positions of the North-West Front was arranged for the 8th November.

It may therefore be concluded that the *grouping* of the troops for the intended active operations, and the *staff arrangements* were correct. The causes of the failure of the fighting on Papas-Tepe were of a different character, which will be explained in due course.

The Fighting of 6th—8th November.

At 7 a.m. on the 6th the siege artillery opened fire on the targets already detailed, and continued it, with breaks, throughout the day. Under cover of this fire the 12th Tunja Bulgarian Regiment began to advance by rushes against Papas-Tepe, and by evening arrived, without great loss, on the saddle which formed the foot of the hill on which the Turkish front line of trenches lay.

The fire of the heavy artillery was so powerful and accurate that the Turks evacuated part of the trenches, and even, it appears, abandoned the strong point, in which there was no cover against shrapnel. The Turkish reserves were also dispersed, and ran for shelter to the ruined village of Marash. But in the numerous folds of the ground and in the undergrowth, scattered parties found shelter, and when the artillery ceased fire on the approach of darkness, they again occupied their trenches.

On the approach of darkness the 12th Regiment attacked the front trenches, and in spite of heavy rifle fire and numerous losses they drove out the Turks and captured the trenches. At about midnight they left the trenches and advanced to the attack of the strong point, but ran into a wire entanglement, came under heavy rifle fire and under the cross-fire of artillery, and were thrown back on the front trenches, from which ere long a Turkish counter-attack drove them to their original position.

In this unsuccessful attack the regiment lost more than 1,200 men, and in their retirement they did not succeed in recovering their fallen comrades, whose bodies showed eloquently, even in March, after the fall of the fortress, the line where the attack of the 12th Regiment was defeated by the Turkish magazine rifles.

On the same day at 3 p.m. an enterprising infantry attack, made in

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combination with the action of artillery and cavalry, was successful in capturing Kartal-Tepe, where the Bulgarians set to work keenly to entrench themselves.

On the North-West Front the artillery combat continued all day, with some advantage to the side of the Allies. On the 7th the Turks made several efforts to recover the lost position, and to defeat the Bulgarians on the West Front, but they were foiled by the fire of the heavy and field artillery of the Allies. On this day the Turkish batteries made fairly good practice, as their fire was corrected from the balloon which was sent up in the fortress beyond the range of the shrapnel fire of the siege artillery.

On the 8th the artillery fire was continued all day; the Turks made a bold sortie on the North Section of the North-West Front, but were beaten back by rifle and artillery fire.

At dawn the order No. 407, issued on the 7th, and based on the incorrect news that Papas-Tepe had been taken, was cancelled.

By the evening of the 8th all was quiet. The Bulgarians worked hard at the entrenchments on Kartal-Tepe, and the Turks strengthened the group on Papas-Tepe.

Thus ended the three-days' fighting, the result of which was that it had now become possible to close the ring around the fortress, while the development of active measures against the North-West Front was seen to be impossible.

In the opinion of the author the failure of the attack on Papas-Tepe was due, not to the incorrect grouping of units, but to technical faults in the fighting.

(1). Although the position was one of only field character, it was strongly fortified with obstacles and strong points, and therefore the attack upon it should have been well planned and systematic. As soon as the front line of trenches was captured, it was necessary to entrench it, to await the dawn, and to reconnoitre in order to find out exactly what there was at the summit, near the tomb.

Further advance should certainly have received the support of the heavy artillery. It was impossible to trust to the results of the fire of the previous day. Or they might have carried the front trenches by daylight, so that they might have been able to reconnoitre the strong point in time for a night attack. It appears also that connection was lost between the attacking infantry and the supporting artillery. It is plain that they should not have assaulted the nucleus of the Papas-Tepe Group until they had fortified the captured trenches, awaited the dawn, restored communication with their artillery, regulated its fire, reconnoitred the character of the strong point by daylight, and taken measures to demolish obstacles if such were found to exist. Thus theory teaches, and the Bulgarians, who usually were wonderfully punctilious in carrying out the lessons which they had learnt in peace time, on this one occasion failed to do so, and paid heavily for it.

(2). The artillery of the attack did their work well. They drove the Turks from their trenches, did not allow their reserves to come up and weakened the fire of the batteries of the defence. But the action of the infantry and that of the artillery were not simultaneous. The assault

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of the infantry took place a long time after the artillery fire had ceased—it was no case of switching the fire elsewhere—and the Turks were given time to regain order and reoccupy their trenches—the same mistake which the Russians committed at Plevna.

(3). There was no connection between the action of the infantry and artillery of the *various sectors*. According to Semenov, they "did not know on one bank of the Arda what was taking place on the other." If the infantry on the North-West Sector remained inactive, this is explained by the intention to postpone the *main task* until the following day, but the inaction of the infantry on the East Front is quite inexplicable.

These were the causes of the failure of the attack on Papas-Tepe. Kartal-Tepe was also a position of field character but without obstacles and generally weakly fortified, and the swift, enterprising, action of the attack was entirely suitable and was crowned with success.

What is generally noticeable about the three-days' fighting is the definite, well-trained system in the preparation, and the utter want of system in the execution. The war training of the staff was good, but it is possible to blame them for their refusal to try once more the capture of Papas-Tepe, after correcting the technical errors of the first attempt. With the failure of this attack, the whole of the intended operations broke down, and active measures had to be temporarily abandoned.

As to the action of the garrison in this period, it may be recognized as sufficiently enterprising. Recognizing, no doubt, the importance of Papas-Tepe and Kartal-Tepe, the Turks by a series of resolute sorties strove to retrieve the lost positions and attempted to drive the attack from the positions of investment. The firing of the fortress artillery was satisfactory. But the *insignificant strength of the sortie columns* doomed these actions to certain failure. This radical fault of the fortress staff was noticeable in all the actions of the garrison throughout the siege.

Events from November, 1912, to March, 1913.

With the fall of Kartal-Tepe the ring of investment was completed. Repeated efforts were made by the Turks to recover the lost position, and sometimes not without success.

Thus, on 11th November they succeeded in recapturing it by an enterprising sortie, and this important position remained in their hands for some days, but it subsequently passed back, and this time permanently, into those of the 8th Tunja Division.

On the 12th November, after the arrival of all the regiments of the Servian Danube Division, the final disposition of the troops, which remained in force up to the fall of the fortress, was effected (see Plan No. 4).

The Servians, forming the IInd Servian Army, under General Stepanovich, occupied the North-West and West Sectors.

(1). North-West Sector :—The Servian Timok Division (13th, 15th and 20th Regiments), 7th Regiment, Danube Division, and one (55th) regiment, 11th Bulgarian Division. Sector commander, Colonel Kondich.

(2). West Sector :—Three regiments, Danube Division (8th, 9th and IVth). Commander, General Rashich.

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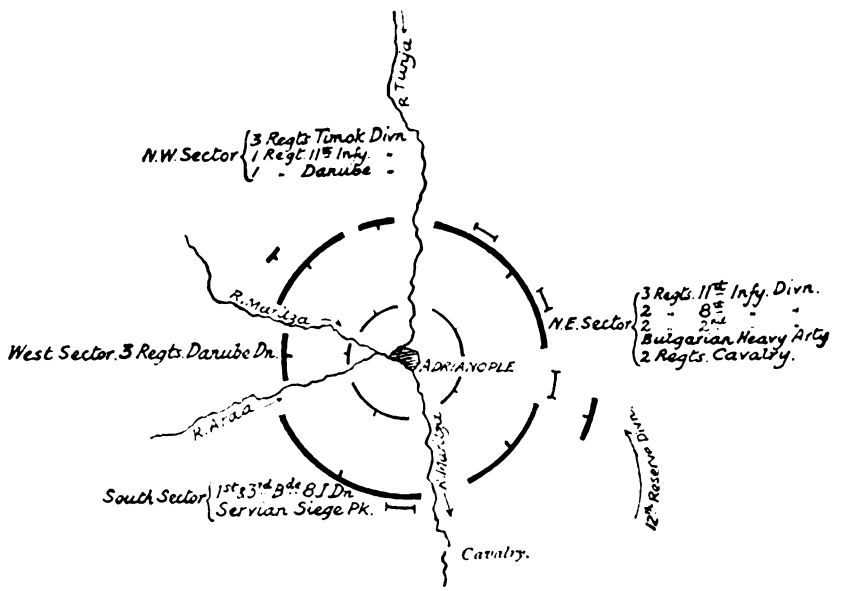
(3). South Sector :—1st and 3rd Brigades, 8th Tunja Division. Major-General Kirkov.

(4). East Sector :—Three regiments, 11th Division, 2nd Brigade, 8th Division, 3rd Brigade, 2nd Division, Life Guard Cavalry Regiment and Timok Cavalry Regiment. Major-General Yelchev.



PLAN NO. 4.—*Distribution of the Siege Armies in the last period of the Siege.*

Changes were made in the siting of the heavy artillery. About the middle of November two 15-c.m. L/30 guns, and two 12-c.m. L/30 guns were transferred to the East Front. Later on, a 12-c.m. L/28 battery of the Shumla Battalion and two 15-c.m. howitzers of the Sofia Battalion were sent to the same front.

Two 15-c.m. L/30 and two 12/c.m. L/30 guns were mounted at the Kiushen Farm, and two batteries of 15-c.m. howitzers with one battery 12-c.m. L/28 guns were placed at the village of Musubeili.

The works of transporting these guns, of excavating cover for them and of mounting them, were entrusted to the battery commanders, and 180 *bullock carts and* 100 *pairs of bullocks were allotted to them for the purpose. Neither sappers nor working parties from the infantry were given them.*

The commanders of groups were obliged to co-operate with the battery commanders in supplying means of transport, through the medium of the Commandant of Siege Artillery, IInd Army.

The closing in of the siege batteries, which was decided upon in the 7th November, was accomplished during the latter part of the month ; it was decided to begin firing by batteries, at effective range, upon the works of the North-West Front and rear, and therefore a heavy siege division was ordered to be transferred to batteries already prepared on the east of Kemal. Two groups were formed, as follows :—

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The first :—

2 batteries, 12-c.m. L/28	..	.. 8 guns
1 battery, 12-c.m. L/30 ..	..	.. 4 ,,
1 battery, 15-c.m. L/30 ..	..	.. 2 ,,

was to occupy the first section, with Papas-Tepe, Bekchi-Tepe, the village of Marash and Kazan-Kiupriu as objectives.

The second :—

1 battery, 15-c.m. L/30 ..	..	.. 2 guns
1 battery, 12-c.m. L/28 ..	..	.. 4 ,,

was to occupy the position on the north side of the Kemal-Kara-Smailcha road, which formed the left section, with Kazan-Tepe and Shaitan-Tarla as objectives.

The change of position was carried out by batteries, chiefly by night, beginning from the right flank, and 150 bullock carts and 60 pairs of bullocks were allotted for the purpose.

In this manner all the heavy artillery of the North-West Sector was closed in 1½ to 2 kilometres nearer to the Turkish positions. The light siege division had already been closed in by the 7th November.

It was now naturally hoped that the efforts of the Allies would be turned towards contracting the ring of investment, by advancing and entrenching nearer to the fortress positions. This actually took place on the West, South, and East Sectors, as the result of collisions which occurred between the combatants during the middle of November.

On the night of the 14th—15th the troops of the North-West Sector were ordered to capture the high ground near the farm Yekmekchi-Keui and the Uch-Tepeler position ; those of the East Section were to carry the advanced positions Maslak, Sapunjilar and Mezyar-Tepe, while those of the South and West Sectors also received tasks against some others of the Turkish advanced positions.

On the North-West Sector the attack was made without vigour, and failed not only to capture the advanced positions, but even to make any advance. On the East Front the attack was met with heavy fire, but, though the advanced positions of the Turks were not captured, the line was advanced to the next ridge, Baalr, within 1½ to 2 kilometres of the previous position.

On the South Front the Bulgarians captured the village Daudjaros, and pushed forward their left flank.

At the same time the Servian Danube Division pressed forward towards the front trenches of the Turks on Papas-Tepe, and dug themselves in on the ridge within 1¼ kilometres of the latter. With regard to this operation the Bulgarians reproached their Allies with having failed to capture Papas-Tepe, forgetting that the position was now much stronger than it had been when they themselves failed in a similar attempt.

Immediately after their move to the East Front, the groups of heavy long-range batteries began a bombardment of the town and suburbs. They fired on the mosque of Sultan Selim, and dropped five shells into it, one during divine service, and killed several mullahs. They shelled the Turkish quarter, the bazar and the suburb of Karagach. Shells struck the building of the Russian consulate, the Bulgarian church, the Greek consulate and the officers' club, but generally the town suffered

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little. The attempts to demolish the flour mill at Karagach were unsuccessful.

From time to time aeroplanes flew over the fortress, scattering proclamations which called upon the garrison to surrender. The flights of the Bulgarian Lieutenant Petrov were distinguished by especial boldness. He was reported to have dodged the fire of rifles and of guns of 10·5-c.m. calibre and of special Krupp design, although the shrapnel were well timed, by skilful manœuvring, rising and sinking to disconcert their aim. But he maintained an elevation of at least 4,000 ft., and could do but little reconnoitring from such a height.

The efforts of the Turks during this period were directed towards recovering the lost positions, but did not succeed. Later on, hoping that the Servians were less skilled in warfare than the Bulgarians, they directed their sorties against the West and North-West Sectors, but these were always repulsed by fire.

On the 2nd December the armistice was declared.

This period of the siege was characterized by *stubborn fighting for the advanced positions*. The great importance of the latter, *e.g.* Uch-Tepeler, Yekmekchi-Keui, 154, Kadin-Keui, etc., showed plainly how successfully they had been chosen, allowing in the fullest extent *mutual fire support* to one another. This was the cause of the ill-success of the attacks on the North-West Front. Without taking these positions it was impossible to commence active measures against the main position, and in addition they would have made it necessary twice to change the positions of the heavy artillery, with the inevitable loss of time involved thereby. Thus did the advanced positions play their parts.

During the armistice, which lasted two months, it became evident, from the stubbornness with which the Turks refused to yield up Adrianople and from their trust in their Chatalja Army, that further active operations would be necessary against their threatened capital, Constantinople.

Meanwhile they worked hard at the fortifications of the Chatalja position, their last rampart. Its framework consisted of old forts of the Adrianople type, but its strength lay in its fieldworks and powerful artillery. Its flanks were protected by the sea, and the troops defending it were the *élite* of the troops of Asia Minor, who had not been demoralized by the previous disasters.

The attack on such a position *without the co-operation of heavy artillery* could not end successfully, and also the men and equipment of the IInd Army were urgently required for the reinforcement of the Ist and IIIrd Armies, so that the very early fall of Adrianople became urgently necessary. In this period of peace negotiations *the enormous importance of fortresses generally, and that of Adrianople in particular*, were sharply emphasized.

Adrianople closed the railway, on which it was indispensable to base all the Bulgarian armies ; it attracted to itself an army of 100,000 men, with all its technical equipment ; it was an object of pride and moral support to the spirits of the Turkish Army, and formed the strongest trump card in the hands of their diplomatic agents during the peace negociations in London.

Fortunately for the Allies it was not a modern fortress, equipped in

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every way for defence and *proof against assault.* If it had been they would have been condemned to a slow, exhausting siege, with fighting for each foot of ground; so much time spent on the near approaches, so much on the glacis, on the works flanking the obstacles, and so on. In all probability such a struggle, with only 15-c.m. guns, and only a limited number of siege guns, would have been beyond the power of the Allies, it would certainly have required much more time, numbers and *matériel.* The results of the war would have been far different.

This military object-lesson must enhance the importance of well-constructed fortresses, which have rather lost popularity in recent years.

In accordance with the terms of the armistice the Bulgarian trains were allowed to pass through the fortress to the Chatalja position. This was a great mistake of the Turks, and especially of the commandant of the fortress.

The *moral* of the garrison, supported up to now by the lying reports of Shukri-Pasha, telling of Turkish victories, fell as soon as the truth was disclosed. The trains passing to the south eloquently confuted the fables of the commandant, and foreign newspapers, officiously supplied to the Turks by the Allied officers, enlightened the garrison as to the true position of affairs.

The commandant ought to have demolished the bridge over the Arda, as he did later, throwing the blame on some subordinate officer, and diplomatically excusing himself for what had happened.

There were no hopes that the fortress would fall from starvation or want of military stores. The Bulgarian trains, as they passed, saw large herds of sheep, and the men of the garrison had no appearance of men suffering from starvation. It was necessary to take the fortress as quickly as possible, and no means remained but assault. The preparation for the assault began forthwith, during the armistice, and continued up to the 22nd March.

Measures in Preparation for the Assault.

It has already been explained that the capture of the fortress depended upon the capture of the works of the North-West or of the East Front. For the first of these it would have been necessary to begin by making a fresh attempt upon Papas-Tepe, correcting the faults which were noticed previously. There is no doubt that an attack from this side would have required larger resources than one on the East Front; yet it might have succeeded, for the works were unfinished, were not proof against assault, and the trenches were without shrapnel-proof head cover, although the whole strength of the sector lay in these trenches. An assault on this sector might have been made at a much earlier date, as the preparatory measures were already completed, the heavy artillery deployed, and the lines of approach well reconnoitred. If it had succeeded peace might have been concluded earlier, and the Allies would not have incurred the loss of men which resulted from their long sojourn before the fortress in the cold and inclement season of the year.

But the troops in the North-West Sector were Servians, and it was morally impossible to impose the main task upon them, and to require of them the special enterprise and heavy losses which such a task would involve. Adrianople was wanted by the Bulgarians, and it was for them

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to spare no efforts in the capture of it, but it would have been a radical error to change rounds yet a fifth time, and to set to work anew to learn the ground with fresh troops.

For this reason the staff of the siege armies decided, at the possible cost of loss of time, to capture the forts of the East Front, which, as already explained, was the weakest. The right angle formed by the North and East Sections of this front, with Fort Aivas-Baba in the salient, favoured the enfilading of the fortress positions; while the sharply defined ridge, with the well-seen, high-standing forts, facilitated the ranging of the heavy artillery, and allowed them to support the attacking infantry up to the last minute of the assault. The attack on this front, if properly organized, promised certain success.

While the armistice was still in force the Bulgarians moved forward their infantry on the North and East Fronts to the outpost line, and proceeded to entrench it vigorously. It is said that Shukri-Pasha protested, but nothing came of it.

The Turks also entrenched, chiefly on the east side, but without plan or system. Very long trenches were excavated, with traverses and communications, but no measures were taken for protection against artillery fire.

The transfer to the East Sector of all the heavy artillery from the West and North-West Sectors also began. It was carried out as described above by bullocks, round the positions of investment. The terrible roads and the snow, which now fell in great quantity, created incredible difficulties. The operation took two months, and every care was taken to conceal it from the garrison of the fortress. On the West Front *two*, and on the North-West *six* guns were left in position, and these from time to time carried out rapid fire in co-operation with the field artillery. On arrival in their new positions the batteries fired only a few ranging rounds, and those only at the same time as the field artillery, which masked the siege guns by their fire. They stood silent up to the moment of the assault in March, when their fire came as a complete surprise to the Turks.

In February a part of the Servian Siege Park, numbering 28 howitzers, arrived and was detailed for the South Front, where it was decided that the subsidiary attack should be made.

At this time once more the want of means of aerial reconnaissance in the fortress was badly felt, as it must have disclosed the presence of such masses of batteries, in spite of the measures, roof coverings, etc., which were taken to conceal them.

If in the early part of the siege the Turks showed no great enterprise, now, when their spirits had finally fallen, they hardly showed their presence, except that the fortress artillery kept up a bombardment of the positions of investment, but failed to do them any harm.

Only on the 9th to 11th February they made a sortie in comparatively large numbers, about six battalions, on the East Front in the direction of Musubeili. This might have ended sadly for the Bulgarians if it had been made in larger numbers and with more enterprise and system. Taking advantage of the relief of the outposts and of a fog, the Turks burst into the line of investment, drove back the outposts and almost reached the siege batteries. But the Bulgarian detachments which

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were present kept their heads, collected into groups and charged forward with the bayonet. The Turks retired suffering heavy losses.

Description of the Positions of Attack in the Last Period of the Siege.

In the *West* Sector the Servians had their nearest trenches on the first ridge from the saddle, at a distance of 1 kilometre from the Turkish trenches. Their works took the form of a succession of rifle trenches, which ran from the Arda to the Maritza, of the profile "firing standing on the bottom of the trench," with *bonnets* (mounds between the firers). On the right flank the distance between the opposing lines was ¾ kilometre, and on the left 1½ kilometres. From this line the communication trenches to the rear were well distributed and skilfully applied to the ground, some of them being wide and deep enough to allow of ammunition wagons being drawn by their teams along them.

On reverse slopes and in the trenches of the second line there were made abundant casemates of light construction and dug-outs in folds of the ground. All the batteries were in concealed or half-concealed positions, entrenched, with high bonnets reaching to the top edge of the gun shields. They were rarely placed in a single line, but more frequently, even on level ground, were echeloned by sections or single guns. In rear of the guns were shelters for ammunition wagons, connected with the guns by communication trenches. Generally this Servian front of attack showed good engineering talent in its defence.

The right flank of the *North-West* Sector—the area of the Servian Timok Division (20th, 15th and 13th Regiments) with its artillery, and of the 55th Bulgarian Regiment—began, on the bank of the Maritza, with the section of the 20th Regiment, at the tombs which lay 5 kilometres from Kazan Kiupriu, the flank fort of this sector. From there the front line of Servian trenches followed the ridge, which ran 2 kilometres west of Kadin-Keui, to the hill 1 kilometre from Yekmekchi-Keui. This second section, that of the 15th Regiment, was the nearest to the line of forts, though still 3 kilometres from the Shaitan-Tarla Group, because of the Turkish advanced positions. From here the section of the 13th Regiment ran north to Sarai-ak-Bunar, where that of the 55th Regiment began. These positions were fortified only with rifle trenches, communications, and field casemates.

The position of the 55th Regiment consisted of groups of trenches occupying the hill Eski-Injernik, the ravine of the Maimun-Dere, and the farm on the bank of the Tunja. Its distance from the Uch-Tepeler advanced position was 2 kilometres, and from the line of the works Eshil-Tepe and Yasi-Tepe, 4 kilometres.

The original main positions of investment on the North-West Front had now become rear positions.

The positions of the *North-East* Sector began with the section of the 56th Regiment, 11th Division, at the village Eni-Keui on the bank of the Tunja and ran towards the crest of Balik-Serti. Eni-Keui was prepared for defence From here they ran on the crests of Balaban-Serti and Balaban-Alcha, where they approached within ¾ to 1 kilometre from the Turkish advanced trenches in the area of the Forts Koyalik and Tash-Tabiya.

Thence they ran to the hills Dikili-Tash, Kakara-Bair and Arap-

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Tarla, in this section approaching to within 2 kilometres from the Fort Aivas-Baba. The fortification works consisted of trenches for firing standing, field casemates for reserves, and communications.

The East Section began at the river Provadiisca, where its right flank was ¾ kilometre from the Maslak advanced position. From here the front ran to the crests of Baalr, a kilometre to the west of Musubeili.

The left flank lay on a ridge within 1 kilometre of the Mezar-Tepe advanced position, and 1 kilometre west of the Kiushen Farm.

The whole of the North-East Sector was dug up into a mass of trenches, redoubts, communication trenches and field casemates. The redoubts occupied the commanding hills, and between them there ran uninterrupted lines of rifle trenches of various profiles, in two to three rows. In most places the trenches were made on the "military crests," badly concealed and visible from a long distance.

Trenches and casemates were liberally fitted with light roof coverings for protection from shrapnel and splinters, but there were no casemates the roofs of which were proof against 6-in. or even against 3-in. common shell. An abundance of light types, and good concealment, on reverse slopes and in ravines, gave protection against common and high-explosive shells.

From the Constantinople road to the Maritza was the section of the composite cavalry brigade, and here there were separate troop or section trenches made at wide intervals apart.

As regards the *South* Sector, the author regrets that he was unable to obtain accurate plans. In the headquarters no plans were obtainable. All that were obtained by him were supplied by the courtesy of individual Engineer officers, and the officer who knew the dispositions on this front was absent. The positions of the attack began at the village Akhar-Keui, and ran to the ridge of Hill "97," which was south of the Pamuk-Serti advanced position. Here the Bulgarian and Turkish trenches were about 1 kilometre apart.

The centre section, Kartal-Tepe, was strongly fortified, and also the left, in the neighbourhood of Doujaros, on the bank of the Arda. This village was in the hands of the Bulgarians and was prepared for defence Here, in places, the opposing trenches were only ½ kilometre apart. The Bulgarian trenches followed the line of the ravine which lay 1 to 1½ kilometres to the east of the village, on both sides of the Karagach—Orta-Keui road, while the Turks held the opposite bank.

The trenches of the South Front were better applied to the ground, had lower parapets and good concealment.

In all the sectors of the attack serious measures were taken towards improving communications, roads were repaired and bridges were made over various streams. On the East Front five bridges were made over the Sazli-Dere alone.

In anticipation of the assault stores of engineering tools and materials were collected in the village Biiuk-Diuliuk, at the redoubt which was nearest to the Provadiisca, opposite the Maslak position, and in Musubeili.

In the regimental lines it is said that model obstacles were constructed, on which the troops were exercised at demolitions and crossing. It was noted with interest that, judging by the models, the staff of the siege armies apparently expected to find more serious obstacles than

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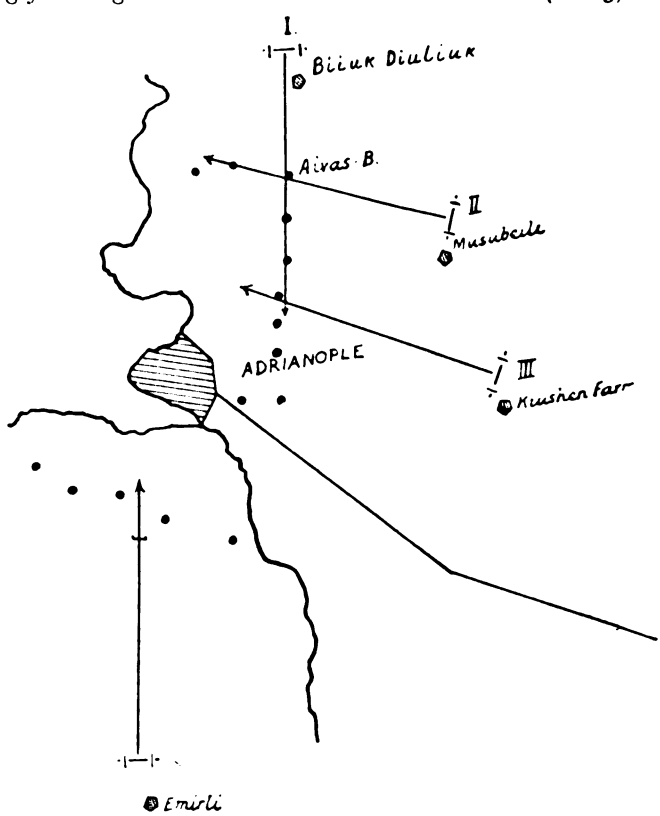
really existed. According to the Bulgarian officers and rank and file, these obstacles, and the demonstration of the difficulties which the attacking troops must undoubtedly expect in an assault, had a *demoralizing effect* on their soldiers, who did not conceal their dread of the "terrible wire entanglements with which the whole fortress was surrounded." But all the same these obstacles proved of valuable service to the troops who attacked the East Front.

That the staff overestimated the strength of the defences, especially on the North-West Front, may be proved from the reports of foreign war correspondents, who while publishing highly exaggerated accounts, averred that the information had been given to them by the staff of the IInd Army. From this, one of the following deductions must be made, either that the staff actually overestimated the strength of the works opposed to them, or that they wished to exaggerate the exploits of their army. The writer accepts the first alternative, expecially as it is confirmed by the measures taken in preparation for the assault.

Of the *Heavy Artillery*, the Bulgarian was mounted, as mentioned above, in the East Sector, and the Servian in the South, with the exception of the few guns mounted for demonstrations in the North-West and West Sectors.

The main objectives of attack were the Forts Tash-Tabiya, Aivas-Baba and Aidji-Yolu, and the grouping of the heavy artillery was accordingly arranged as shown in the attached sketch (No. 5).



PLAN NO. 5.—*Grouping of the Heavy Batteries.*

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The first "*North*" Group, of 34 *guns*, was placed in the area which lay about 1 kilometre to the north of Biiuk-Diulliuk. The batteries were well concealed as they lay in the valley of the Keosh-Dere.

The range of fire of these guns was little less than 4,400 yards to Aivas-Baba, and 3,300 yards to Tash-Tabiya. This group could enfilade the eastern line of forts and batteries as far as Kuru-Cheshmi (8,800 yards).

The second group, the "*North-East*," of 34 *guns*, lay in the area between Musubeili and the Provadiisca. Most of the guns were behind a second ridge (false crust) and had as objectives the Forts Aivas-Baba and Aidji-Yolu. They could also enfilade the North Section from Aivas-Baba to Tash-Tabiya. Range 6,000 yards.

The third, the *East Group* of 30 *guns*, lay in the neighbourhood of the Kiushen Farm, and was intended to attack the other forts of the East Front, Aidji-Yolu, Kestenelik, etc. Mean range 5,500 to 6,600 yards.

This made a total of 98 heavy guns on the East Sector. As regards the grouping of these guns it is interesting to notice that here the Turks had fortified the Maslak and other advanced positions, which should have been, theoretically, *at such a distance from the fort line that the heavy artillery of the attack could not from one position fire effectively both upon the advanced positions and upon the forts.*

It would appear at first sight that the Turkish advanced positions, with the one exception of Maslak which was only 1½ kilometres from the forts, did fulfil this requirement; but the Bulgarians, taking advantage of the passiveness of their enemy, posted their heavy artillery in this case *almost in line with their infantry*. In this way they were able to act effectively against both, the advanced positions at ranges of 2,200 to 2,750 yards, and the main front at 5,500 to 6,600 yards. The latter task was facilitated, in spite of the great distance, by the sharply defined ridge with the well-seen forts against which they were firing.

If the Turks, leaving the advanced positions Mezar-Tepe and Eski-Kumluk unaltered, had occupied, instead of Sapundjilar and Maslak, the heights of Baalr on the east, and had made a fortified group near Biiuk-Diuliuk on the north, the conditions would have been much less favourable for the Bulgarians In this case the fighting for the advanced positions and that for the main front could not have taken place almost simultaneously, as actually occurred. The staff of the fortress would have had time to discover the true intentions of the attack and could have taken measures accordingly.

On the *South* Front the Servian howitzers (twenty 12-c.m., and eight 15-c.m.) were mounted in positions very well chosen on the reverse slopes of Hill 97, on the north of Emerli. The objectives of these howitzers, which had a very long range (8,800 to 9,900 yards) were the concrete batteries of the Turks, armed with 15-c.m. guns, and the forts of the South Front ("Demirdesh"). The range was from 6,600 to 7,150 yards.

All local objects, including many tombs, which were suitable for observation posts, battery and group, were prepared as such, and were connected by a complete network of telephones. One single artillery system required more than 100 kilometres of cable.

The direction of fire was in the hands of *one man*. The transference

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of fire and designation of targets were facilitated by the squares into which the Bulgarian map was divided.

For supplying the batteries with stores *intermediate artillery parks* were provided, for the North Group at the village of Murad-Chali; for the North-East Group in the valley of the Sazli-Dere, near the Musubeili road; for the East Group at the Kiushen Farm; and on the South Front in the valley of the Emerli-Dere. There were in addition *group expense magazines* near the battery groups. The main artillery park was at Mustapha-Pasha. In this way the supply of stores was well secured. All the batteries were entrenched, and the greater part had shrapnel-proof coverings to the gun portions.

Some of the field batteries had similar coverings. Not only were separate gun emplacements connected by communication trenches, but also separate batteries. In these deep trenches recesses were excavated, in the Boer method, in which the gunners hid when the batteries were under the fire of high-explosive shells. These caused a great sensation, but the men were not afraid of shrapnel.

Spare batteries were prepared at Musubeili, in the valley of the Sazli-Dere and at the Kiushen Farm. The measures preparatory to the assault may be taken as patterns. The choice of the main front of attack (the east), the subsidiary (south) and demonstration fronts (north-west and west) was quite sound. The distribution of the troops, the grouping of the heavy artillery, in fact all the measures for ensuring success were thoroughly thought out and provided for, and were executed *with the maintenance of the most rigid secrecy*. In orders it was recommended to the officers to be very cautious in their conversations, and the rank and file were forbidden to speak to civilians, foreigners or newspaper correspondents.

It was probable beforehand that the assault must end in success, without heavy loss or any unfavourable complications, as from the carefulness which the details of preparation were worked out, the chances of the intervention of all-powerful "accident" were reduced, practically to nothing.

(*To be continued*).

[For the convenience of our readers the Map of Adrianople is again issued. Several important alterations and additions have been made to this Map, and it is not proposed to publish it in any later *Journal*.—ED., *R.E.J.*].

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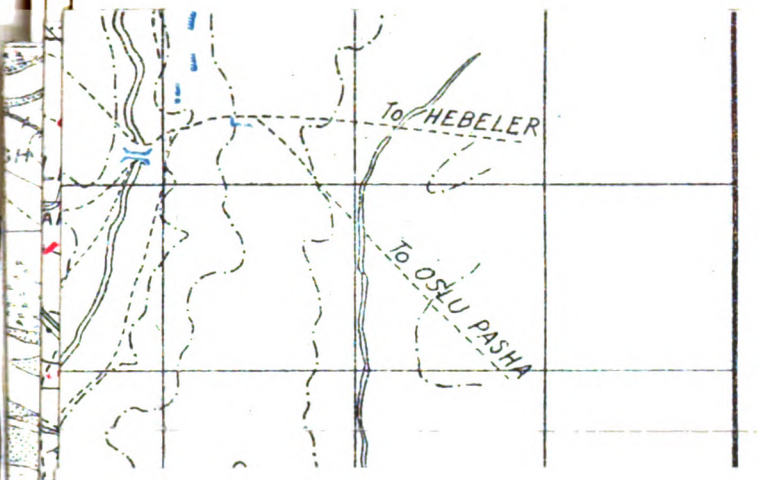

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REVIEWS.

APPROXIMATE ESTIMATES.

By MAJOR T. E. COLEMAN, S.I. of W., R.E. Services.—(32mo. E. & F. N. Spon, Haymarket, S.W. 5s. net).

THIS book contains much useful information, especially for the purpose of estimating by rough quantities. Pp. 1—23 deal with the preparation of estimates, and include tables giving the proportional value of labour and materials in various trades, and the proportional cost of each trade in various types of buildings. Then follow four pages on the various methods of executing works, and pp. 28—37 give the current rates of wages and the prime cost of building materials in London.

The prices for various works follow, arranged in alphabetical order with numerous cross-references, and the whole information is often printed under different headings, which makes the book larger than necessary but saves time in reference. Prices are given for detailed work, in many cases cost of labour and materials being given separately, as well as for buildings complete by cube rate. The unit rate for buildings is only given in a few cases. The book is obviously written more for civil than for W.D. use, as for instance Asylums are given two and a-half pages and Barrack blocks only half a page. Some useful "Building Notes and Memoranda" conclude the book.

TRENCH'S MANŒUVRE ORDERS.

Revised Edition by LIEUT.-COLONEL B. M. BATEMAN, R.G.A.—(1914. Price 2s. Wm. Clowes & Sons, Ltd., 31, Haymarket, S.W.).

THIS well-known little handbook is now in its twelfth edition and will be found most useful to students. It contains 12 chapters dealing with General Principles, Writing Orders, Tables and Data, March, Combat, and Halt Orders, Night Operations, Convoys, Local Defence Orders, Martial Law, Passage of a River or a Landing, Standing Orders, with two Appendices.

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NOTICES OF MAGAZINES.

KRIEGSTECHNISCHE ZEITSCHRIFT, 1914.

Vol. II. contains a criticism of an article by C. Dienstbach in the *Scientific American*, in which the author traverses the French opinion that the superiority of aeroplanes over airships is due to the fact that the former can rise more rapidly. The machine-gun and its adaptation to aircraft has, in his opinion, altered the case, for, assuming that an aeroplane to avoid machine-gun fire must rise to 2,000 ft. above an airship, the latter can avoid a falling bomb, which at this height takes 13 seconds to fall, by using the steering apparatus, while in a machine-gun duel the airship has the advantage, as it can mount a larger armament. No mention is made, however, of the disadvantage that is caused by its larger bulk.

There is an account of a field-bridging equipment introduced into the Austrian field artillery. The bridge which is built up of T steel to form a trussed girder can be made in three lengths, 5 ft. 6 in., 11 ft. 0 in. and 16 ft. 0 in. The latter requires stores from two batteries. All three bridges will take the battery guns and wagons and also the heavy field howitzer. The stores are carried in the battery wagons and need no extra transport.

Vol. IV. The Goerz-Leppin Signalling Apparatus is described. It is a miniature searchlight with a concentrated beam for attachment to an ordinary pair of Goerz binoculars for use in night signalling. The current is provided by a dry cell which, with a spare, is contained in a handy case carried at the back on the waistbelt. There is also a tripod attachment for use when sending or receiving long messages. Unfortunately the cell requires to be filled with water 10 hours before using, and to be kept upright. It then has a life of six months under normal conditions. The range of the beam, which, owing to its concentration, is inconspicuous, is said to be $7\frac{1}{2}$ miles under good atmospheric conditions. It is practicable to use it at a range of 3 to 4 miles.

Vol. V. contains an account by Colonel Frobenius, a well-known writer on military subjects, of the Swedish fortifications at Boden, the central point of the defence of the Swedish-Finnish frontier. The fortress, commenced 1899, was completed only a few years ago.

E.R.

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Rivista di Artiglieria e Genio.

March, 1914.

Some Considerations of Mining Operations at the Siege of Port Arthur.

While the greater number of the military reports on the operations around Port Arthur relate to operations in the open field, there are very few notices of the war of subterranean mining. This last, however, is particularly studied in a long and able paper published by Capt. Genez of the French Engineers in the journals of the *Revue de Génie Militaire* of May and June, 1913. It chiefly refers to the operations around and within the Forts No. II. (Kikuan-Nord), No. III. (Erlung-Est) and the Work No. 3 (Sung-shari Shan). The articles are in the form of a diary, and are well deserving of study by all students of military science, treating as they do with technical dispositions and furnishing examples of patriotism and personal courage.

The fortifications dealt with by the author are those which, from their adherence to the principles of siege warfare, were best organized for the defence. These were works constructed on rocky ground, with parapets adapted for rifle fire, light artillery, and quick firers (Fort No. III. had also a central battery of 4 cannon of 150); with ditches, but not all furnished with efficient flanking defences; and with badly lighted casemates wanting the indispensable conveniences for a garrison which was required to hold out as long as possible.

The thickness of the cemented walls, which according to the general plan and organization of the place should have been able to resist shells of 210 m.m., were reduced to resist those of 150 only, because it was supposed that the Japanese had no guns of greater calibre. It is not to be wondered at that, under the action of shells of 280 m.m. which with immense labour had been transported to the place, the casemates were damaged and the walls broken in large masses, thus enabling the attack to advance to the covered way and to obtain access by mining to the vital parts of the works.

From the account of the subterranean warfare against the three works of fortification above mentioned, the following conclusions are arrived at:—

1st. It is especially evident that the Russians did not think it possible that this kind of strife could be carried on in so hard a soil as that surrounding the greater part of the works. When, under the immediate pressure of the attack, they became convinced of their error and decided to do something, they found themselves wanting in men and in the means of the special organization that was necessary to carry on hastily an organized plan of countermining with any prospect of success. The defensive subterranean works—commenced too late and badly prepared—naturally were unsuccessful. Not being confronted with a system of countermines, the assailants were able to advance near to, and practically in contact with, the vital parts of the works, overcoming all obstacles to their advance and profiting by the large craters produced by the shells and mines to commence their covered and hidden sap, and in the end to gain the parapets.

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2nd. A fact deserving special notice was the different grades of resistance offered from the flanking defences, and especially from those of the counterscarp. Wherever countermines had been prepared for the defence of the latter, there was determined and protracted resistance. In the attack on Fort Kikuan-Nord, in the counterscarp of which galleries for countermines had been constructed but only partially developed, three weeks elapsed before the assailants could come into contact with the counterscarp and finally capture it. In the Fort Erlung-Est the countermines constructed by the defence proved of little success.

Isolated galleries for countermines of some importance were constructed in certain secondary works, as for example ;—the caponiers " Hatskimaki " flanking the Fort No. III., and the two redoubts Panlong-Est and Ouest. For the defence of these caponiers a simple gallery was tardily commenced against the enemy's neighbouring approaches, but the attack becoming aware of this in time changed the direction of its works, placed its approaches outside the radius of the countermines, and rendered about three weeks' work useless.

These facts show *how precarious are flank defences unless protected by a permanent system of countermines* and the great danger to which the works are exposed which are not provided in time with this most important method of defence.

3rd. After the fall of the counterscarp, the resistance that the Russians could oppose in the flanking galleries was able to hinder the enemy for some little time and to inflict severe losses, but the latter gaining ground little by little, always succeeded in finally dislodging the defenders.

The assault made by the Japanese on the works was in every case prepared by means of mines, and almost always in exactly the same way, viz., by opening large breaches in the counterscarp, creating slopes in the parapets, and finally by placing large charges of explosives below these. On the day fixed for the assault, a tempest of fire was hurled on the works, the parapets were razed to the ground by formidable explosives, followed by the rush of the assaulting columns which easily succeeded in establishing themselves on the smoking ruins of the work. Under similar circumstances, the defenders of a fort which was not guarded against the subterranean approaches of their adversaries by an efficacious system of countermines, would infallibly be destined to succumb in a short space of time.

4th. The experience of Port Arthur shows that any system of defences *above ground* on the glacis of a work, is powerless to arrest the mining operations of the assailants. The Russians employed in their defences, in addition to the fire of rifles and artillery, great quantities of hand grenades without succeeding in stopping the subterranean advance of the Japanese. Nor did the numerous sorties have a better result. In fact, there was no lack of personal valour at Port Arthur on the part of the defenders or of tenacity in strife ; but one of the most efficacious means of defence was wanting, viz.—a well-organized system of countermines.

5th. One thing that strikes the student. and which is without precedent in the history of sieges, is the quantity of explosives employed

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in the mines, especially by the Japanese. It is said that in order to obtain decisive effects against these modern works of fortification, it became necessary to use great quantities of powerful explosives, for which numerous depôts had to be prepared, and means taken for the transport of these materials in rear of the troops destined to operate against the strong places by means of a regular siege.

6th. Cases were not wanting in which the explosions in the chambers of the mines prepared by the defenders caused damage to the galleries and the walls of the works, thus facilitating the invasion by surprise and *viva forza*. This may be attributed to an incorrect estimate of the radius of explosion for various charges in respect to the positions of the galleries and walls. To avoid the formation of dangerous tunnels and breaches in their own works it is necessary not only to take exact account of the relative position of the branches and chambers of the mines, but also of the types of the galleries, to note their depths, distances of the neighbouring galleries and mines, and finally the possibility of the earth offering less resistance in one part of the zone than in another, owing possibly to the prolonged action of heavy artillery, and to craters caused by their projectiles.

It should also be noted that the countermining galleries should be excavated at a sufficient depth, not only for security from fire, but also because chambers can be prepared from them with strong charges and great radii of action, rendering it difficult for the enemy to excavate galleries below them.

7th. Owing to the want of ventilation in the portions more directly exposed to subterranean attack, and to the haste with which the defenders tamped their mines, these places were often filled with asphyxiating gases caused by the explosions, which produced severe results; whilst the darkness in which they were immersed owing to defective lighting was sometimes the cause of injury and confusion. It is necessary when tamping mines in modern fortifications to consider how to ensure proper ventilation and sufficient lighting.

8th. More than once the Japanese assaulting columns were delayed in front of the ditches of the works for want of adequate means of crossing. It is only necessary to realize what the efficacy of rifles and mitrailleuses is at short distances, to understand what ruin is caused to the assailants who are exposed to it even for a few minutes. Fortunately for the Japanese the Russians did not always seize on the right and critical moment of the assault, and the assailants were in consequence able to rush forward and obtain possession of the ground at a very short distance from the parapets.

9th. Another very important element of a general nature that requires special attention in subterranean warfare, is the intimate relations which should exist between the sappers and the riflemen in the attack of a fortified position.

In the assaults undertaken by the Japanese during the last period of the siege *a battalion of sappers* always preceded the infantry units allotted for the attack, and opened the way. It is only by the employment of strong forces of well-trained sappers and miners that the attack of strongly entrenched positions can be made possible. Finally,

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before the advance of the infantry for the occupation of the first position, the sappers have to clear the way for the detachments of the advanced posts and to plan out a systematic defence of the ground to be acquired. They should be provided with tools and various means of destruction specially requisite for clearing obstacles, ascertaining the existence of mines, fougasses and torpedoes, and of paralyzing their effects. The same duties are incumbent on the sappers in each period of the advance up to the final assault. Detachments of engineers proportionate in number and strength to the importance of the work which has been previously reconnoitred, should also precede the detachments in an advance, or when new positions are occupied; other detachments follow with the reserves to reinforce and systematize more effectually the positions.

April, 1914.

ESSAYS ON THE RUSSO-JAPANESE WAR.

The author of these essays, Capt. De Saligny, of the Colonial Infantry of the French Army, is an officer of wide experience and a clear and able writer. His book on the above subject is dedicated to the instructors of the French Army, and is divided into three parts with a short introduction and a preface by General Lacroix.

The first part of the book is entitled "*The Events*," and the facts quoted are verified by the publications of competent eye-witnesses, such as General Hamilton, Colonel Gertsch, and Major von Tetteau. It relates to the causes of the war; to the material and moral conditions of the two belligerents prior to the commencement of the campaign; to their mobilization, and to the successive actions which wasted the Army of Kuropatkine.

It is not merely a bare account of events, but a stirring picture of men and affairs accompanied by most valuable criticism. In parts of the book the author does not hesitate to criticise adversely all those, whether politicians, generals, or officers of the General Staff, who contributed to the Russian disasters in Manchuria. In the 177 pages of this first part, the author succeeds in giving a complete idea of all the events of the war, condensing extracts from about 46 publications of different authors. Five good topographical maps are included in this first part, one of Eastern Asia, another of the theatre of operations, and three representing respectively the ground on which was fought the Battles of Liaoyang, of Scia-ho, and of Mukden.

The second part is entitled "*The Lessons*." The author calls special attention to the lessons that can be drawn from this war, and proceeds to a critical examination of the events from a political, strategic, tactical, and organic point of view. But he makes this examination, not with the intention of confirming preconceived ideas from the events he quotes, but of demolishing instead by their means the French doctrine of war, and of furnishing all his readers with the elements for forming a more correct solution.

From a political point of view his lessons may be comprised in the ancient motto: *Si vis pacem, para bellum;* and he points out constantly that the best diplomats are a good fleet and a powerful army, both well organized, well instructed, and impressed with warlike energy. From

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a strategical and tactical point of view, the passive attitude of the Russians is noted and also the hesitation of the Japanese in certain cases.

The author's views are particularly interesting as regards the artillery, its vulnerability, indirect fire, use of various kinds of projectiles, the danger of leaving batteries in reserve, and the intervention of heavy field batteries. Its increasing importance and its greater moral and material effects are also emphasized. Since the Japanese cavalry was scarce, badly organized and worse mounted, while the Russians employed the worst cavalry that they possessed, the author is unable to derive any teaching from the employment of the cavalry; and limits himself to calling attention to the utility of mixed detachments (cavalry and horse artillery) and of the possibility of that arm executing great charges on the battlefield notwithstanding the deadly fire of modern weapons.

The third and last part of the work is entitled "*The Cause of the Defeat.*" In this part the author studies the organization of the Japanese and Russian Armies, their soldiers, their officers, and their chiefs, showing that to prepare a great modern army for a victorious war, it is necessary to evolve a rational system; to be prepared to take responsibility; to strike blows with audacity and prudence; to work without any other ambition than that of co-operating efficaciously and of carrying out at any cost the plan of the war or of the battles; and for the General Staff to know how to assist the chiefs, working intelligently and without thoughts of advancement, with officers accustomed to taking the initiative, and with soldiers attached to their officers, accustomed to the hardships of the field and well instructed in the use of their weapons.

Such were the generals, the officers, and the soldiers of the Japanese Army, and such were not the Russians.

The Russian officer was well educated but had no inducement to interest himself in military studies. He was deprived of ambition as he had no hope of advancement, but was dependent for promotion on the favours of patrons or of the officers of the General Staff.

The duties of the general officers in peace times were chiefly restricted to the ordinary territorial services, to making confidential reports—generally unfavourable—of those below them, some of whom they had neither known nor even seen. Finally the officers went to the war without interest or enthusiasm, and the result was Liaoyang, Scia-ho, Sandepu, Mukden; defeat and always defeat.

The author makes grave reflections on the Russian generals who held important commands in Manchuria, and especially on the Commander-in-Chief, Kuropatkine, who was for 14 years at the head of the war administration and then led the army to Mukden.

This book does honour to the author, and to the army which possesses officers who study, reflect, and produce books like those of Capt. de Seligny. It is a book which deserves to be read and carefully studied, not only by the instructors of the French Army, but by officers of every grade, and of every army.

FRANCE.

Reorganization of Aeronautic Services.—Towards the end of last year, as was stated in Vol. I., p. 113, of the Rivista of the current year, the aviation service was separated from that of aerostatics.

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This separation is now completed under the new orders contained in the *Bulletin Officiel* of the 16th of March, from which we extract the following : —

1. The direction of military aeronautic material is abolished, and the following special establishments are formed :—

(*a*). *Central Establishment of Aerostatic Material,* which comprises all the services for military aerostatics, and the Laboratories for aerology and telephotography.

(*b*). *Service for Aviation Construction,* which comprises the service for the acquisition of apparatus and the offices for repairs to motors.

(*c*). *Laboratory Aeronautical.*

(*d*). *Laboratory for Aviation.*

Each of these special establishments is under the direction of a superior officer.

2. A *technical section of aviation* and an *inspection of aviation material* is instituted. The first depends directly upon the War Minister and serves to coordinate and direct the studies for military aviation, to examine the inventions laid before the Minister, and to prepare the regulations for aviation service. It is also concerned with the studies for aerodynamics, and with those for the security of aviators, material, armament, and for the attack and defence of aeromobiles. It is under the direction of a superior officer.

The second is joined for administrative purposes to the technical section, and exercises control over the aviation material that is stored near the depôts. We also read in the *France militaire* of the 31st March, that the War Minister has presented a progress of law for the reorganization of military aeronautics. Whilst with this it is proposed to give the sanction of the law to the separation of aviation from aerostatics, it is also proposed to recognize legally the military schools of aeronautics to create a special corps of officers for administration, and a special corps of non-commissioned officers, mechanics and accountants.

The effectives of the aerostatic companies will be increased so as to ensure the use of dirigibles of great capacity for manœuvres ; the number of the companies of such troops will be brought up to twelve, of which eight are already existing and the remaining four will be created as required.

Radiotelegraph Service in War.—The *Bulletin Officiel* of the 9th March publishes the new instructions for the radiotelegraph service of the army which partly modifies the preceding orders.

The field radiotelegraph stations are arranged in networks each of which comprises the stations permanent or temporary placed under the control of the same authorities (commandants of groups of the several areas, and of army corps, and eventually commandants of groups of divisions or of cavalry corps).

The various networks are arranged independently among themselves, and each works with a determined wave length so as not to disturb the correspondence of the others.

E. T. THACKERAY.

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DEMOLITION OF MASONRY WALLS.

Photo 1.

Photo 2.

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DEMOLITION OF MASONRY WALLS.

By CAPT. G. B. PEARS, R.E.

AN opportunity was recently offered to the 2nd (Field) Company, R.E., of destroying with explosive a wall some 8 ft. thick at the top, 30 ft. long and running from a height of 19 ft. at one end to 5 ft. at the other.

This wall formed part of a bastion or redoubt built some 40 years ago at the Delta Barrage, near Cairo. It projected into the river at high Nile, and the Irrigation Department desired its removal as they considered that it deflected the current and caused erosion in the river bank down stream. They therefore offered to provide the necessary explosives, transport, etc., and the opportunity thus provided was gladly taken.

The river was low at the time when the operation was undertaken and the wall stood high and dry above water level. The wall was composed of limestone rubble set in good lime mortar. The end and the re-entrant angle (vide plan) were faced with brickwork, in the former case to a depth of 3 ft. The rubble and mortar had set in the course of years to the consistency of lime concrete, and it was found necessary to sink holes with 1½-in. boring bars. It had been hoped at first that, in the case of the horizontal holes at any rate, it would have been possible to cut in for placing the charges with brick chisels or crowbars, but this proved impossible.

It was desired not merely to loosen the wall, as in the case of blasting rock, but to obtain fairly complete demolition, and for this purpose the *Manual of Military Engineering*, Part IV., did not give much guidance because it was not practicable to follow the procedure therein advocated, viz., to work out the value of the co-efficient K and thereby apply the table on p. 79.

Molesworth's Pocket Book (p. 83) gives an extract from Lefroy's *Handbook of Field Service*, and the formula for the case of a masonry wall 8 ft. thick without counterforts, attacked with charges at two-line intervals, gives a result of 9·6 lbs. of powder. This seemed high ; nor could any other definite data for masonry

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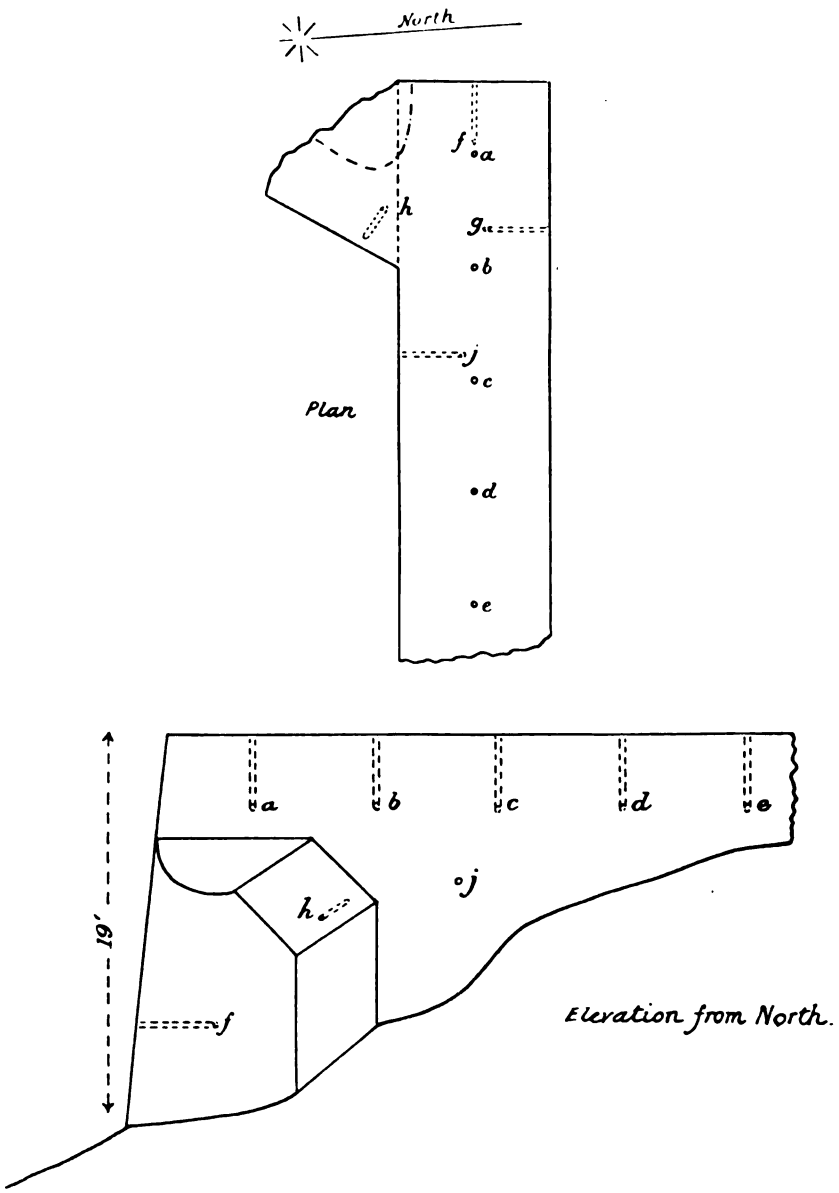
be found in either *Hirst's Pocket Book* or Guttmann's *Work on Blasting*.

The charges were placed as shown in the plan and elevations of the wall. A total amount of 24 lbs. of gelignite was used, distributed fairly evenly between the boreholes. The average charge per borehole was just over 2·5 lbs.



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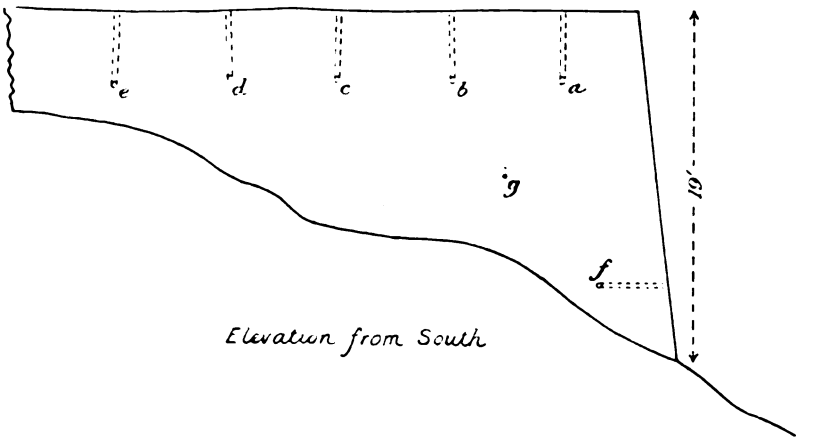
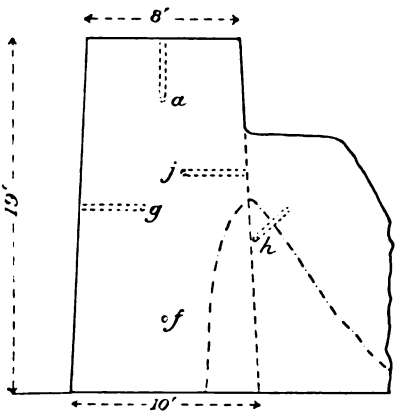


Elevation from South



End Elevation.

The chain-dotted line shows the portion left standing.

a b c d e f	@	2·5 lbs.	total 24 lbs.
g h j	@	3 lbs.	

As the cartridges of gelignite were too small for the diameter of the borehole, they were gently pressed with a wooden rammer as they were put in one by one, until the paper wrapper burst and the gelignite was forced into contact with the sides of the hole. By doing this, about 1·25 lbs. of explosive per foot-run could be put into the hole; they were then tamped with fine river sand in the usual way.

A party of 25 N.C.O.'s and men started work at 8.30 a.m., and the charges were fired simultaneously by electricity at 1 p.m. A total of 4½ hours was thus taken to bore and charge the holes.

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Demolition was complete, and the wall was thoroughly disintegrated and reduced to a heap of stones. Only a portion at the angle of the buttress remained standing and this could have been knocked down with a few blows of a pick as it was cracked in every direction.

None of the charges appear to have blown out of the boreholes and no stones from the wall apparently were projected further than 50 yards.

Photo 1 was taken while the boreholes were being drilled; *Photo* 2 immediately after the explosion. The two photographs were taken from the same spot.

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DELHI DURBAR.

REPORT ON THE DRAWING UP OF A SCHEME OF CONCENTRATION AND DISPERSAL OF TROOPS FOR THE CORONATION DURBAR, 1911.

IT was recognized from the first that the concentration on, and dispersal from Delhi of the large number of units detailed to attend the Coronation Durbar, was a matter requiring considerable forethought and the co-ordination of a number of different departments and separate railway administrations. In order to effect this and also to gain experience which promised to be most valuable, it was decided to draw up the scheme on the lines already used for concentrations for war.

A special traffic officer having experience of war concentration schemes was therefore deputed from the North-Western Railway to work in collaboration with the Quartermaster-General's Office, and to draw up the tables of stock and arrange the time-tables in consultation with the railway administrations concerned.

It was first intended to concentrate all dismounted troops by rail on four stations in the manœuvre area outside Delhi, viz., at Meerut, Hapur, Khurja and Gurmukhtesar; and no cavalry or artillery were to rail. When the monsoon showed signs of failure the manœuvres were abandoned and it was decided to concentrate a reduced force of all arms by rail on Delhi itself. Subsequent rain assured a sufficiency of fodder, and it was finally decided to rail the infantry of three divisions together with a howitzer brigade, one regiment of cavalry and the most of the Imperial Service troops consisting of cavalry and infantry, all other troops being ordered to march.

The two abandoned schemes were worked out in detail, but it is unnecessary to consider them further as they were never submitted to actual test.

The problem therefore consisted in transporting to and from Delhi a force drawn from all parts of India, at the same time as the railways were exceedingly busy with public Durbar traffic. A table was prepared in the Quartermaster-General's Office showing the units, the railway over which they would travel, the number of trains they would occupy and their detraining and entraining stations at Delhi.

The method followed in drawing up the concentration scheme was as follows :—

At a meeting of traffic managers held at Delhi early in the year

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it was decided to allot the period between the 19th and 25th November inclusive to the carrying of troop traffic, and not to make any engagement for other special trains between these dates until troop trains had been fixed. These dates had been fixed with regard to manœuvres, but although the manœuvres were abandoned the dates had to be retained as railways had already made their arrangements on this basis.

All broad-gauge railways agreed to accept a load of 33 vehicles, which allowed of a battalion of infantry being taken in one train. The Oudh and Rohilkhand Railway, East Indian Railway and the North-Western Railway for trains below Lala Musa, were prepared to take a load of 45. On the metre gauge, the load was limited to a maximum of 40, but the average load was 30.

The next step was to prepare a rough scheme on the basis of assumed time-tables so as to ensure that trains should arrive at suitable hours and at suitable intervals. In this the capacity of the three main camp stations, Army Camp, Cavalry Camp and Imperial Service were primarily considered and all trains were arranged to arrive by daylight. In deciding the order in which units were to arrive, the deciding factors were the capacity of the lines leading into Delhi and the necessity for the greatest possible economy in rolling stock.

The capacity of the lines had previously been ascertained from the traffic departments of the railways, with most of whom this, and similar matters, were settled by personal interview.

The question of economy of stock had not received special attention in the war concentration schemes, but for the Durbar concentration it assumed great importance owing to the heavy public demand that there was certain to be at the same time.

The arrivals were therefore so arranged as to allow of each rake of stock being used as often as possible by the same kind of unit, it being left to railways themselves to take advantage of this if they wished to do so. The time allowed for turning the stock round at Delhi was a minimum of six hours, and six hours' daylight were given at entraining stations. The system was worked out to the fullest extent on the North-Western Railway where many rakes were used four times over in the seven days concentration lasted.

The rough scheme thus worked out was submitted to railways, who worked out the time-tables to conform as nearly as possible to the proposed departures and arrivals, and finally the timings over the Durbar Railway were allotted. Meanwhile the tables of stock were under preparation, and here considerable delay was caused by the necessity for reference being made to divisions by the Quartermaster-General's branch before final figures could be supplied, as in many cases the strengths sent up were wrong and had to be sent back for correction. This, combined with the unavoidable alteration

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of two or three units who had to be changed at the last moment, delayed the issue of the stock tables to railways till the beginning of November, and final corrections were sent out as late as November 10th. No attempt was made to prepare the usual diagrams showing the running of each train, but the stock tables were practically in the same form as those used for the war schemes. An abstract time-table was compiled and printed for the use of the troops.

The preparation of the scheme for the dispersal was a comparatively simple matter. Each railway had an office in Delhi and two successive meetings were arranged with the representatives of the railways and the Assistant Director of Railway Transport. The latter officer had a list of the units, and, as each was brought up in turn, its departure from the camp station and onward timings were arranged by the officer representing the Durbar Railway and the other line concerned. The necessary consideration was of course given to the available accommodation at the camp stations, but owing to the great number of public specials to be arranged for many troop trains had to leave during the night. Stock requirements were communicated direct to railways by the Assistant Director of Railway Transport, and the railways' own special time-tables were issued to troops.

Considering that out of the 81 inwards trains and 91 outwards trains which arrived between November 19th and 25th and left between December 17th and 24th, only four arrived and two left over one hour late, the schemes must be considered to have worked satisfactorily. Perhaps it is more difficult on this account to deduce lessons from them. The following observations are however offered:—

It is useless to expect that a scheme made out beforehand will be adhered to *in toto*, schemes must therefore be elastic and easily altered in detail.

The economical use of stock deserves more consideration than it has had, but must not be carried to extremes in war schemes as this is incompatible with elasticity. The form in which schemes are drawn up is probably susceptible to improvement. The train diagrams were successfully dispensed with for the Durbar. They are in any case in a form strange to railway officials, and it is for future consideration whether a diagram of the nature of a graphic time-table would not be of greater use. The graphic issued by the North-Western Railway both for concentration and dispersal was of the greatest use to the Durbar Railway Staff.

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TRAFFIC REPORT ON THE DELHI DURBAR LIGHT RAILWAY.

By CAPT. C. WATSON, R.E.

THE chief object of the Delhi Durbar Light Railway was to provide a convenient method of carriage between the more important points in the Durbar area and so to relieve the roads of road traffic. During the Durbar of 1903 the congestion on the roads was very great, and the arrangements made for 1911 therefore were on a much more elaborate scale.

The broad-gauge system was designed to serve the important areas lying round Kingsway, Army Camp, Cavalry Camp, Imperial Service, Provincial Camp, etc.: and also to carry the bulk of the spectators to and from the Durbar and Review, but this did not provide very convenient facilities for passengers between the Visitors' Camp area and Army Camp area and the neighbourhood of the Polo Ground, as it was obviously impossible to run a continuous service of trains on the tramway principle over the broad-gauge system. The light railway was therefore originally designed to run from Tis Hazari Maidan (where the terminus was in close proximity to the Delhi tramway system and the Visitors' Camps) to the Polo Ground, serving the Central Camp area, and to the Amphitheatre running through the Army Camps. It was further intended to run a subsidiary branch to Jagatpur to serve the outlying camps of the 7th Division area, but owing to the reduction in the number of troops these camps were not utilized and this branch was not laid.

It was also thought necessary to give better facilities to the Visitors' Camps lying in the neighbourhood of the north wall of the city, and this would have been best served by extending the line from Tis Hazari to Kashmir Gate. As this was impossible owing to want of space, a branch was laid at the Mori Gate which was only a few hundred yards away.

On the basis of the report of the previous Durbar it might have been expected that the railway would be largely used by passengers willing to pay a fairly high fare, but the large number of motor cars in use in Delhi during the Durbar had considerably altered the conditions, as will be seen hereafter.

Alignment.—The general alignment was as follows:—The head-quarters which included a large stabling yard, loco. yard and washing line was situated on the Tis Hazari maidan. The main platform was situated on the turning loop connecting the up and down lines, and from the loop a line took off giving access to the yards mentioned above. The Mori Gate branch had a separate platform. From Tis

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Hazari a double line ran in a northerly direction between the Ridge and the Civil Lines, with stations at Hindu Rao and Flagstaff and a junction at the point where the Alipore road crosses the Ridge. From Ridge Junction the Polo line ran parallel to, and south of, the Mall, with stations as follows:—Probyn Lines where it crossed Probyn road, Mall where it crossed Kingsway and was close to Kingsway Station (broad gauge), Princes road Bandstand where it passed at some distance behind the massed bandstand on the Polo Ground, and Polo close to the west entrance to the Polo ground. Bandstand Station was intended to serve certain Visitors' Camps which were never pitched, hence it was useless as a passenger station but very necessary for train-working purposes. The distance from Tis Hazari to Ridge Junction was 2 miles and from Ridge Junction to Polo $2\frac{1}{2}$ miles or $4\frac{1}{2}$ miles in all. The journey including halts nominally occupied 28 minutes. The Amphitheatre line ran north from Ridge Junction, crossing the Alipur road by an overbridge, with the following stations:—Chandrawal, near the XI. Lancer Lines, Range, VII. Division in the area allotted to that division, Najafgarh where it crossed the Najafgarh drainage cut, III. Division near the south end of the III. Division Camp, V. Division close to Army Camp Station (broad gauge) and the Ordnance Park and Supply Depôt where the line turned west to Jaroda and Bhorari road on either side of the Composite Division. The distance from Ridge Junction to Bhorari road was 5·7 miles and from Tis Hazari 7·7 miles, and the normal running time including halts was 55 minutes. There was some controversy over the name V. Division which was allotted before orders were given that the V. Division would not move to Delhi. It was decided to retain the name as it appeared in the map of the *Durbar Railway Guide*, which had been issued some months before.

These lines were double throughout and a turning loop was provided at Bhorari road and Polo, so that trains were never reversed but ran continuously round in a closed curve. This arrangement allowed of the offside of the vehicles being enclosed with wire netting, which permitted the tracks being laid very close together and also prevented passengers entering or leaving the train on the wrong side.

The Mori Gate branch was a single line with a loop at each end extending from a subsidiary platform at Tis Hazari to a point outside the Mori Gate about 400 yards away. Except at Mori Gate, Tis Hazari, Polo, Bhorari road and Ridge Junction stations were provided with an up and down platform just long enough to take a train of 14 vehicles. At Tis Hazari and Polo there was a single platform on the turning loop and at Bhorari road there were five platforms in succession round the loop, only the first of which was used except on the day of the Durbar. Ridge Junction was not a passenger station as the formation of the Ridge made it impossible to get in

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the necessary length of fairly level ground, so that passengers travelling between the Amphitheatre and Polo lines had to change at Flagstaff at which station there was an overbridge.

Station Facilities.—Each station was provided with a separate entrance and exit gate on each platform. Both exit gates were as a rule used, but it was quite impracticable to get passengers after taking their tickets on one side of the station to walk round to the other side by a level crossing and enter by the proper gate ; in fact little attempt was made to get them to do so, as it would have entailed a larger ticket-collecting staff, and there was no difficulty or danger in allowing them to cross the line. At Flagstaff, the overbridge was used for this purpose when there was a train in the station, but scarcely ever otherwise. Special arrangements were made at Tis Hazari where the booking was very much heavier than at any other station and, until the troops arrived, was as a rule about equal to all the other stations put together. Two large pens each about 120 square yards in area were made, each having two entrances and an exit on to the platform. The entrances of one were coloured red and placarded AMPHITHEATRE and of the other green and labelled POLO. Convenient to the entrances was a booking office with two windows, and near by in the station building were two more booking windows, one of which was reserved for Upper class passengers and was close to a separate Upper class entrance direct on to the platform. Lower class passengers were induced by means of the direction boards and by men stationed at the entrances to get into the pen corresponding to the train they wanted to catch, and their tickets were checked at the entrance. As soon as a train had come in and the passengers had left by the exit gates, of which there were two, the pen corresponding to the direction the train was to take was opened, and the waiting passengers came in and filled up the train at once. As a further guide to passengers there was a green or red target on the front of each engine, a similar placard on the near side of the engine and a green or red notice displayed on the platform—these were marked POLO and AMPHITHEATRE respectively. The engine targets and placards were marked TIS HAZARI on the reverse side and were turned round at Polo and Bhorari road. At Flagstaff there was also an arrangement of notices showing the destination of the next up train and informing passengers of down trains that they had to change for Amphitheatre or Polo as the case might be. A man was also told off to call out the destination of trains and see that passengers were not overcarried. These arrangements were not in use from the beginning but were added as their desirability became apparent. The Mori Gate branch was served by a shuttle train connecting with the main line trains at Tis Hazari. Tickets issued at Mori Gate were available for a through single journey of any length, and there

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was a direct connection over a level crossing between the main and branch line platforms at Tis Hazari. The line was seldom if ever used by the inhabitants of the Visitors' Camps for whom it was built, but the Lower class passenger soon discovered that by taking a ticket at Mori Gate he could escape much of the crush and congestion which was often unavoidable at the Tis Hazari booking office. It was thus a public convenience to a very limited extent, but a loss to the railway.

Train Service.—The line was opened from October 10th between Tis Hazari and Polo. Trains left every two hours between 7 a.m. and 5 p.m., *i.e.*, six in each direction, and the fares were Upper class 4 annas and Lower class 1 anna. The low fare quickly attracted a large number of sightseers from the city who used to go out to Mall and Polo Stations and thence walk to the Amphitheatre through the Chiefs' Camps or to the Polo Ground, from where they could see the various official camps. The line was also used by a considerable number of clerks and others who had business in the Durbar area and lived in the city. From the curve of earnings given it will be seen that Friday, the Mohammedan holiday, and Sunday were always busy days and this is a fair index of the type of passenger carried. By Sunday, the 15th, it was found necessary to double the train service. On the 18th a time-table was introduced giving a 30 minutes' service morning and evening and an hourly service during the day amounting to 14 trains up and down. On Sunday, the 22nd, 26 trains had to be run in each direction.

On the 1st of November the fares were doubled, *i.e.*, Upper class 8 annas, Lower class 2 annas and at the same time the Army Camp branch was opened. A half-hourly service was run to the Polo Ground throughout the day, and an hourly service to Bhorari road. It was expected that large numbers of people would take advantage of the opening of the Amphitheatre line to visit the Amphitheatre, but though the earnings did not drop, the number of passengers decreased for some time, it being apparent that the increase of fares prevented many of the original sightseers from continuing their trips. Moreover great numbers of people had already seen the Amphitheatre, having walked there from Mall Station through the Chiefs' Camps. The curve of earnings will show, however, that traffic gradually went on increasing with the same characteristic rises on Fridays and Sundays.

On November 19th troops began to arrive and, although the city was out of bounds, large numbers of soldiers made use of the line travelling to and from various football and hockey matches on the Polo Grounds and also to the bazaar which had sprung up in the vicinity of Hindu Rao. The service on the Amphitheatre branch was therefore doubled from November 20th so that there was a half-hourly service up and down in both directions between 7 a.m. and

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6 p.m. and on the 22nd trains left Tis Hazari up to 9.30 p.m. Up till this time some use had also been made of the railway in conveying military working parties to and from their work and in carrying stores belonging to the Ordnance and Supply and Transport Corps.

Towards the end of November the Visitors' Camps began to fill and as the trains were being very crowded it was thought desirable, after considerable discussion, to introduce as a maximum Rs.1/- Upper class, 4 annas Lower class and 2 annas Soldiers' tickets from 1st December. In coming to this decision it was rightly foreseen that the line would not be used to any great extent by Upper class passengers except on special occasions such as the Durbar. The increase of fares did not materially reduce the number of passengers, the earnings went up with a rush and even with 15 minutes' service on each branch, which was running during the busy periods of the day at this time, trains at certain times of the day were running absolutely full. The greater number of passengers consisted of people from the city going out to the Central Camp area. Next in importance was the military traffic between the Army Camps and the Polo Ground area and civil station and when there was any football match between British units this traffic was very heavy. The hockey matches between Indian troops did not give us so much traffic as many more of the spectators seemed to prefer to walk.

It is also noticeable that the usual increase in earnings on Fridays was swamped by a marked increase on Thursdays which was the day on which troops had leave as a rule.

The total number of passengers carried was over 704,000 and the earnings over Rs.1,30,000/- during the 80 days on which the line was open for traffic.

Special Occasions.—The first break in the ordinary working occurred on December the 5th when the State Entry was rehearsed. On this date, and on the State Entry itself on the 7th, traffic was interrupted in the early morning and in the middle of the day to allow troops, Native Chiefs' escorts and the procession itself to cross the railway. In order to make the best use of the times when the line was open, stock was run out at an early hour in the morning towards Polo and Bhorari road, so that as soon as the line was open a full service in both directions could be started. It was found that the restrictions on running trains were somewhat too severe and on the day of the State Entry itself trains were run for a somewhat longer period, advantage being taken of every opportunity to get them over the level crossings. Normal traffic continued from the 8th up to the 12th, Durbar Day, for which special arrangements were made. The only other occasion on which the ordinary traffic was interrupted was December 17th, the day of the State Departure. On this occasion the line was again blocked for about two hours at

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various points to allow troops and chiefs to cross, and again in the afternoon for the passage of the Royal Procession which, however, only took a few minutes.

In order to meet the demands of traffic on special occasions, trains were stabled at Polo and Bhorari road when opportunity occurred and were started off again as required. Polo trains were also cancelled and run on the Amphitheatre line and *vice versâ* as circumstances dictated.

Traffic continued heavy up till about the 20th December but in spite of the fact that the fares were reduced to 8 annas Upper class and 2 annas Lower Class on the 18th there was a sudden drop on the 21st and the train service was gradually reduced, the Amphitheatre line being closed on the 24th and the Polo line on the 28th.

Observations Class of Passenger.—The points of interest which have come to notice are as follows :—Owing to the large number of motor cars and the unexpected facilities for getting about in private vehicles by road the line was not much patronized by Upper class passengers, and had the capacity of the line been greater it seems likely that more money would have been made if lower fares had been charged, say 2 annas Upper class and 1 anna Lower class, increasing to double these amounts during the Durbar period. It was, of course, impossible to carry more passengers than we did from the last week of November till the close of the Durbar, and the capacity of the line could only have been increased by using higher capacity stock, which was not available, or by quadrupling the line between Tis Hazari and Ridge and by running more trains which was impracticable.

It was a source of loss to us that we had to reserve one vehicle at least on each train for Upper class passengers. This vehicle generally ran empty or was occupied by pass holders of whom there were a large number. If the Upper class fare had been reduced as proposed above it would probably have paid us handsomely, but with a large proportion of Upper class vehicles on a train the practical difficulty of sorting out the passengers would have been felt.

Time-Table.—The great advantage of being able to run a regular service of trains every few minutes was apparent. There was no necessity for passengers to carry a time-table as they knew they would not have to wait long for a train, and if they were constant passengers they soon got to know the time trains passed. It was often noticed at Mall Station that there was a rush for the booking office from people walking along the road whenever a train appeared, thus showing that a frequent service is in itself the best method of drawing passengers, as passengers of this class would never have dreamt of walking into Kingsway or Delhi Main and taking a ticket on the chance of there being a train ready to start.

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Publicity.—Until the East Indian Railway Camp Press was opened the difficulties and expense of getting time-tables, handbills and posters printed in the bazaar were great. As soon as the press was opened, it was possible to distribute thousands of time-tables and special handbills. At the same time the want of special publicity arrangements was felt. It was impossible to arrange long beforehand what fares, time-tables and special arrangements might have to be notified, and there was no adequate means of advertising available. There was an agency in the city ready to distribute bills, notices, etc., but more than this was desirable and a special department might well have been organized jointly for the broad gauge and light railway which would have possessed an organized service of billposters, sandwich men, handbill distributors, etc., and at the same time arranged for the design and printing of the bills and notices, thus greatly relieving the executive officers. That the latter were able to do so much, is due to the invaluable services of the East Indian Railway Press.

System of Train Working.

Equipment.—The whole line with the exception of the Mori Gate branch was double. At Tis Hazari, Polo and Bhorari road termini there was a turning loop so that trains had not to reverse but ran round and round with the same vehicle always leading. Each station except Ridge Junction was equipped with a double-arm main signal opposite the station building, and a station limit board 600 ft. from each end of the platforms. Ridge Junction was fitted with interlocking home and outer signals worked from a cabin. Each station was connected to the one on either side by a telephone, and Bhorari road, Polo Ridge Junction and Tis Hazari were all connected to an exchange switch board.

With the exception of two block stations, which were introduced between Tis Hazari and Hindu Rao and Hindu Rao and Flagstaff, all stations were "B" class, *i.e.*, permission to approach could be given while the station was occupied by a train. The two block huts were "A" class and permission to approach them could not be given until the previous train had passed into the section ahead.

In order to allow of stock being held in reserve against rushes of traffic at the conclusion of football matches and similar events, it was found necessary to put in relief sidings at Polo and Bhorari road. These were found to be of great value.

As a precaution against entire dislocation of traffic by derailment or break-down a cross-over was provided at Najafgarh. There was also a cross-over at V. Division to allow trains to shunt into an engineering siding, and another cross-over was put in at Tis Hazari Station on which stock or engines could be reversed.

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System of Working.—To commence with, the system of working was the ordinary one in use on the double line where block instruments are not installed. The Station-master having a train to despatch asked the next station ahead if line was clear, and on receiving intimation that it was so together with a private code he filled in a starting permit and gave it to the driver. It was found that when the full service of trains was running the number of telephone messages involved was too great, and in order to lessen the work falling on the Station-master it was arranged that no line-clear enquiry message should be sent, but that as soon as a train arrived at a station the Station-master should send back an "In" report together with a private code. This was the authority for the Station-master in rear to send on another train as soon as he required to do so. This system worked well and greatly lessened the congestion on the telephone instruments. It was not thought practicable to dispense with the starting permit, as none of the stations were provided with a starting signal and some check on a train leaving the station without permission was found necessary. Both these systems were provided for in the Traffic Working Rules, a copy of which accompanies this report. The starting permit forms were those in use on the North-Western Railway, but the form for permission to proceed without line clear was found to be much too cumbersome, and a new form on the lines of the starting permit, but printed in red ink, was introduced.

On Durbar Day a modified system of working was introduced in order to allow of trains leaving the Amphitheatre at the quickest possible interval. This is described under a separate heading.

Working of Junction.—In order to distinguish Polo trains from Amphitheatre trains and to assist the staff at Ridge Junction to put them on the right line, the following arrangements were made:—An "Out" report for each up train from Tis Hazari was telephoned direct to Ridge Junction giving its destination. Polo trains were provided with a green target and green buffer lights on the front of the engine, Amphitheatre trains carried a red target with white buffer lights, but as these could not be seen until the train had come right up to the Ridge Junction outer signal, the staff was dependent on receiving correct information from Tis Hazari. The distinctive targets and lights were of considerable use to the public who soon got to know their signification, and these were supplemented by similarly coloured boards on the platform at Tis Hazari and Flagstaff, at which latter station passengers between Polo and Amphitheatre had to change trains.

Time-Table.—The working time-table was drawn up on the assumption that not more than 16 trains per hour could be dealt with at Ridge Junction Cabin, *i.e.*, one every 3 or 4 minutes. This gave a 7-minute service in each direction between Ridge Junction and

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Tis Hazari and a 15-minute service on the two branches beyond Ridge Junction, and it was found that this was the practical limit to punctual work.

The following observations are offered on the various points which arose :—

Terminal Accommodation.—Tis Hazari Station was provided with a single platform on the turning loop, and as trains arrived and left at intervals of 7 to 8 minutes the available time for coaling and watering or changing engines or cutting off damaged stock was exceedingly limited. It would have been a great convenience had there been two or more platforms on loops parallel to the main line, so that trains could have had a longer halt.

The necessity for extra platforms at Tis Hazari was also very evident when, owing to some temporary block to traffic, down trains followed each other at close intervals. These could not be dealt with more than one at a time at Tis Hazari, and as each train had to be coaled and watered there were continual stoppages at signals and in stations in the down direction which was very aggravating to the public. The provision of extra platforms as noted above would have met this difficulty. As it was, the only method of surmounting it was to shunt trains out into the stabling yard on arrival at Tis Hazari and keep them there until normal traffic was restored. This required a certain amount of previous arrangement and could not always be done on the spur of the moment.

Signalling and Block Working.—In order to deal with as heavy traffic as eight trains an hour in each direction, which was the full time-table between Tis Hazari and Ridge, it would have been more satisfactory to have had starting signals and to have done away with the starting permit, and an ordinary three-position block instrument would have been a great convenience so as to do away with the necessity of telephone messages. These could probably have been borrowed from the North-Western Railway without incurring extra expense, and when it is considered that the passage of 16 trains an hour over sections of only a quarter of a mile in length necessitated the interchange of at least 32 telephone messages per hour and the filling in of 128 entries in the train registers and 16 starting permits, it will be understood that the Station-master's work was heavy and delays to trains were difficult to avoid.

Telephones.—Telephonic working gave some difficulty at first as the staff was not used to it and great difficulty was experienced in transmitting the private letter code. This was obviated by using a number code instead, and after some practice all went well. At first there was great difficulty in getting the telephones properly installed and maintained owing to the great strain under which the Telegraph Department was working. Latterly a separate inspector was detailed to attend to the light railway after which

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failures were exceptional. It is certain nevertheless that it would have been much more satisfactory if the North-Western Railway Signal Department had installed and maintained the installations. They could have supplied a more suitable type of instrument and a better-trained and more adequate staff.

Traffic Working Arrangements on Durbar Day, December 12th.

Facilities.—The object to be attained was to convey the greatest possible number of people to and from the Amphitheatre, from and to Tis Hazari and intermediate stations. To attain this object it was arranged to concentrate all resources on the Amphitheatre line and close down the Polo line, the Central Camp area being sufficiently well served by the broad-gauge system. There was thus left a double line consisting of 13 sections, the longest of which was ·6 of a mile, most of them being ·5 mile or less. At the Amphitheatre there were five successive platforms. The first of these was the ordinary Bhorari Road platform used daily. Of the others the fourth only was designed for detraining passengers and was named AMPHITHEATRE, but the whole were intended to be used for entraining. Only two platforms therefore were fitted with exit gates and all five had two entrances each. These entrances were of the type found by experiment at Tis Hazari to be the most suitable, and consisted of a narrow passage wide enough for only one passenger at a time, with a gate at the end.

The object of the five entraining platforms was to be able to entrain as many people at a time as possible and to get them on the move. In order to allow of trains getting away five at a time in this way it was necessary to abolish line-clear working for a portion at least of the down journey, and as the country was level and fairly open as far as Range Station this portion of the line was worked on flag signal.

Special Instructions.—The following are extracted from the rules which were issued, and explain what the system of working was intended to be :—

1. The line between Ridge Junction and Polo will be closed down until all spectators have left the Amphitheatre which will not be until late in the afternoon.

2. Commencing as soon as passengers begin to arrive at Tis Hazari, probably between 4 and 5 o'clock, trains will be run out to the Amphitheatre branch at 5-minute intervals, see time-table.

3. The last train carrying passengers will leave Tis Hazari at 10.15, but as the last few trains are reserved for passengers holding special tickets, booking must be stopped some time before this. In order to let the station staff know when to stop booking, a special

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white board marked thus + in red will be placed in front of the engine of the third last train by which passengers can be booked. As soon as it passes booking must be stopped and the passengers who have already been booked will be cleared by the next two trains. After these two trains have passed the special trains will come. Only passengers with special passes showing their proper seats in each train will be allowed to go on the platform. Each pass shows the number of the train, the letter on the carriage and a sketch showing the seat in the carriage. Each special train has a number on the front of the engine, and a letter on the carriage. The special trains will be numbered as follows :—The last four to arrive at Amphitheatre are for veterans and will have no mark on the engine (two of these trains will be stabled in Chandrawal Siding early in the day). Before these comes Special No. 12 marked

before No. 12 will be No. 11, etc. It is expected there will be less than twelve specials so that the first will probably be No. 7 or 8. The carriages will be lettered A to O from the front to the brake van.

4. The arrangements at Bhorari Road for up traffic are as follows :—All trains will run direct up to the AMPHITHEATRE Platform (No. 4) and will not stop at the usual BHORARI ROAD Platform (No. 1). Driver must observe the signals on both No. 1 and No. 4 Platforms.

As soon as they have been emptied, they will at once start for Tis Hazari. During daylight they will run as far as RANGE Station by flag signal and will not get any line clear. The method of working is as follows :—Flag signalmen with red and green flags will be posted along the line and men will be posted at the down main signals on the platforms. These men will show a green flag or lower the main signal so long as there is no train between them and the next signalman ahead ; as soon as a train passes them they will show a red flag, or raise the main signal to danger until the train has passed the next signalman ahead, when they will again show a green flag or lower the signal. Drivers will go ahead until they come to a red flag or to a main signal at danger. Then they must come slowly up and halt *close to the flag or the end of the platform* on which the signal is. When a driver sees that the next train is far ahead he should run fast, if it is near he should run slow so as to avoid having to stop at signals. Empty trains returning to Tis Hazari need not stop at any station. At RANGE Station drivers must get line clear to Chandrawal and work on line clear as usual to Tis Hazari.

5. As soon as special train No. 9 has arrived, down empty trains will be stopped and Nos. 9, 10, 11, and 12 and the four veterans' trains will be kept at Amphitheatre. These will be stabled there

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under the orders of the Station-master, Mr. Murphy. The remaining trains will return to Tis Hazari and will be worked up again to Jaroda, from where they will be piloted up by their guards towards Bhorari Road and will draw up close behind the next train in front on the main line. Ordinary passengers may be booked by these trains for any station up to Jaroda.

6. The arrangements for down traffic are as follows :—As soon as the Ruling Chiefs have left, spectators in the official stands will be allowed to leave. Those who brought Rs.4 tickets will each be told the number of the platform to which he should go, and the same number of trains will be run back for these people as were required to bring them up. Gate-keepers must see that only 116 people are let in by each gate for each of these trains. Each ticket collector will be advised of the number of reserved trains. After the reserved trains have left, ordinary Upper and Lower Class trains will be run and 140 people may be admitted to each train.

7. There will be a train on each platform to commence with, and as soon as it is loaded the guard will stand on the *right*-hand side of his engine, and on getting the signal from the officer starting the trains he will order his driver to start. The driver will at once move off running to flag signals as explained in para. 4, and must try to regulate his speed so as to keep moving the whole time, *i.e.*, if the train in front is near he must go slowly, but if it is well ahead he should run fast. As soon as the five platforms are clear five more trains must move up *at once* and the guards of the five waiting trains must always be on the alert to pilot their trains up immediately on receiving the signal, *all trains stabling on the line behind must also keep moving up one by one and guards are responsible for doing this* without waiting for orders.

8. The following are the instructions regarding booking:—All Rs.4 tickets for special trains are being issued from the District Traffic Manager's Office at Tis Hazari. Only return tickets (Rs.2 Upper Class and As.8 Lower Class) are to be issued by stations. If Soldiers' Tickets are required two should be issued to each soldier, or if return Upper or Lower tickets run short, two may be issued to each passenger. If any passenger wishes to travel back who has not got a return ticket he will have to buy a ticket at Amphitheatre, paying single fare. Booking clerks will be placed on each platform to charge anyone found without a ticket at the entrance gate.

9. Fifteen rakes will be required for the up traffic time-table. Two spare rakes will be sent out early to Chandrawal Siding and stabled ready for the veterans, and two will be sent to Mori Gate for the Visitors' Camps specials Nos. 9 and 10. The two remaining rakes for the veterans' trains will run out from Tis Hazari immediately behind special No. 12.

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Up Traffic.—Traffic started at 4.30 a.m. and soon became very heavy, and, although the eighteen available rakes were put in service and those mentioned in Rule 9 quoted above were not taken out of running till the last moment, it was not found possible to maintain a five minutes' service. The up train registers show the greatest number sent in a single hour was 11, and the total number run up to and including the four specials for the veterans was 46. This was somewhat disappointing and is partly due to an engine which got into difficulties with its fire and lost a lot of time at the most critical time of the day. But for this misfortune four more trains at least could have been run which would have earned some Rs.1,500/- at least. As the trains arrived at the Amphitheatre they were emptied either on the Amphitheatre Platform (No. 4) or, if that was occupied, on the Bhorari Road Platform (No. 1). There was some confusion outside the railway fence as the first comers all occupied the reserved blocks on the Spectators' Mound whether they had tickets or not, there being none to prevent them. When the troops arrived to keep the gates, these were all turned out and for a long time were not allowed to get on to the Mound again whether in the reserved blocks or not, some few went straight back by train, many others never got on to the Mound at all.

Down Traffic.—In order to clear away as many as possible of those who failed to get a place on the Mound and so reduce the crowd when the Durbar was over, the first eleven trains were started off commencing at 1.30 p.m. By the time these had left, the Durbar was over and there remained five ordinary trains, one for each platform, and two reserved specials in the relief siding for the Visitors' Camps. It was expected that before these had left the first trains should be returning from Tis Hazari, *i.e.*, at about 2.45 p.m., but by this time the first train had only just reached Tis Hazari having lost about 30 minutes on the journey, and it did not arrive at Bhorari Road till about 3.45 p.m. There was thus a long pause of over half an hour during which there was no train on the platform. In order to help the returning empty trains as much as possible, line-clear working in the up direction was suspended and trains were run to a time interval as provided for in the Appendix to the Rules. There was of course considerable delay to down trains at Range Station where they had to commence working on line clear, and this was greatly aggravated by the late running of the first train, so that even had there been more rakes in reserve passengers would not have reached their destination any sooner, and the train registers show a continuous flow of trains out of Range Station at the rate of about ten trains per hour. By 5.30 p.m. 38 trains had left and the crowds had been cleared.

It was noticeable that although trains might be standing on all the platforms, passengers always made for the nearest one.

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Five platforms were rather too many to control without previous practice. Arrangements had been made to deal with a much greater crowd than actually assembled and probably three platforms would have been enough.

Observations.—The total number of passengers carried to the Amphitheatre was approximately 13,000 so that, although all that was hoped for was not accomplished, the result was not unsatisfactory.

Ticket Issuing and Collecting Arrangements.

Tramway System.—When the line was first opened for traffic and before all the stations were equipped with their full staff, tickets were issued by the guard of the train in the ordinary way adopted on tramways. It was found that this system had its limits and as soon as the traffic began to increase it was found necessary to issue tickets from booking offices. These were cancelled at the entrance gate and collected at destination.

1903 *System.*—It had, however, been decided by the Railway Board that the ticket-issuing and collecting arrangements in use at the last Durbar should be again introduced. These were as follows:—

Passengers provided themselves with a ticket in the usual way and this was collected from them on entering the platform and placed at once in a sealed box. These boxes were collected daily and tickets checked against issues at each station. The main feature of the system was that tickets were not collected at destination and there was thus no delay or crowding at the platform exits. Although the system was said to work satisfactorily there was reason to believe that a considerable amount of irregularities had taken place and the problem to be solved was how to make this system more susceptible to check.

1911 *System.*—It will be seen that as soon as a passenger got on to the platform no one could question his right to be there nor could it be ascertained whether he had ever bought a ticket or whether he had come in by some unauthorized entrance. It was, therefore, proposed and approved by the Examiner of Accounts that tickets when issued should be dated at both ends and that on entering the platform one half should be torn off and placed in the collected ticket box and the other half retained by the passenger for production when required by the travelling ticket examiner, of whom there were two. Moreover, as the tickets had no station name printed on them and were available for a single journey of any length each station stamped a serial identification number along with the date on each ticket. This provided the following check:—Every passenger had to produce when required a ticket of the proper date and bearing the serial number corresponding with a station from which he could have travelled by that train. The tickets were torn in half at the

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commencement of the journey and could not be used again by a passenger once he had left station limits. As the ticket collector only retained half tickets he could not hand them over to the booking clerk for re-sale. This system was introduced on October 30th. It worked exceedingly well and was soon introduced on the broad-gauge system also. The total number of tickets issued under this system was 580,473 out of which only 5,732 or ·97 per cent. were not accounted for in the sealed boxes.

Description of Tickets.—The tickets themselves were of three classes, Upper Class, white, stamped fare Rs.1/-, Lower Class, yellow, some stamped with 4 annas and others without any value. Soldiers' tickets, red, stamped 2 annas. As the Upper Class fare was only 8 annas after the Durbar period a rubber stamp was used to surcharge the correct fare. The Lower Class tickets without any value stamped on them were used when the fare was other than 4 annas, and a certain number of the 4-anna tickets were surcharged in the printing press with 2 annas. The Soldiers' tickets were always issued at face value.

Return tickets were also printed value Rs.4/- and these were issued on Durbar Day only for special reserved trains. In order to provide return tickets at the ordinary fares on this occasion the Rs.1/- and 4-anna tickets were surcharged with a special rubber stamp and this answered very well.

Coupon books of Upper, Lower and Soldiers' single tickets were also on sale but there was no demand for them. Season tickets were not issued.

As the tickets for each class were available for a single journey of any length and the fares were varied from time to time, it would have been quite sufficient to have had tickets with no value at all stamped on them and to have notified the current cost of the ticket by placards at the booking offices and in the carriages. This was done and acted quite satisfactorily in the case of the Lower Class tickets which had no fare stamped on them.

Collected Tickets.—The locked ticket boxes were collected by the first train every morning and opened in the District Traffic Manager's Office and checked by special clerks. The number collected was compared with the number issued by each station which was given on a slip of paper placed by the booking clerk in the ticket box. The check was carried out as follows :—

All tickets were first examined for correct date and station code number. The total number was then counted and checked against the number issued as shown by the opening and closing numbers on the slip enclosed in the ticket box. The tickets from as many stations as possible were then put in serial order and any further discrepancies noted. These results were tabulated and handed to the District Traffic Manager for scrutiny on the same afternoon.

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There was thus a constant check on the performance of each station and any large irregularities were at once brought to notice and the staff taken to account.

Earnings.—The daily earnings were collected by the first train every morning and paid into the cash office, which the Examiner of Accounts, North-Western Railway, had opened at Tis Hazari. The station accounts were kept on the North-Western Railway system and were constantly checked by a Travelling Inspector of Accounts, with the result that there were no discrepancies of any importance to be adjusted when the line was finally closed.

Establishment.

Source of Supply.—The staff was drawn from various sources. During the preceding months, men had been engaged on North-Western Railway Districts in excess of requirements and these were drafted to Delhi as required, but were nearly all employed on the broad-gauge system. The Oudh and Rohilkhand Railway had promised to provide as many men as possible for the Light Railway but could not send nearly enough to equip the line so that local recruitment had to be resorted to. It was feared that there would be difficulty in getting sufficient men locally of a type suitable for Station-masters and the only available source of supply appeared to be the Army. Arrangements had already been made for the employment of British non-commissioned officers and men as platform inspectors and ticket collectors, but the difficulty in arranging for them to live in their stations made it impracticable to employ them as Station-masters. As it was desirable that Station-masters should be able to speak some English the Indian unit which seemed most likely to be able to supply suitable men was the 2nd (Q.V.O.) Sappers and Miners. Enquiries were at once made and the Commandant arranged to send a detachment of 1 Indian officer and 30 men.

Numbers Employed.—When the line was first opened on October 10th, only sufficient staff was employed to open three line-clear stations. Tickets were issued by the guards at first, but, as the traffic increased, booking clerks were engaged and more line-clear stations were opened; the staff engaged thus kept pace with the volume of traffic. On 27th and 28th October the Oudh and Rohilkhand Railway sent their first batch of men. On November 4th the Sapper and Miner party arrived and after being instructed in their various duties commenced work on the 7th. From November 15th three platform inspectors and 31 ticket collectors were provided from British units not attending the Durbar.

The full staff employed during the Durbar period for equipping 20 stations and running a daily train service of 120 trains in each direction was as follows:—

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	No.	Source of Supply. Local or from N.W. & O.R. Rys.	Military.
Supervising and Office Staff.			
District Traffic Manager	1	1	
Assistant Traffic Manager	1	1	
European Chief Clerk	1	1	
Correspondence Clerk	1	1	
Checkers for Collected Tickets ..	4	4	
Indian Officer, Sappers & Miners (Jemadar)	1		1
Running Staff.			
Guards	20	11	9
Travelling Ticket Examiners ..	2	2	
Station Staff.			
European Station-masters ..	3	3	
Platform Inspectors	3		3
Indian Station-masters	20	14	6
Booking Clerks	38	38	
Ticket Collectors	38	21	17
Telephone Clerks	28	16	12
Points and Signalmen	37	37	
Chowkidars	10	10	
Assistant Station-masters	26	20	6
Total ..	234	180	54

Note.—The District Traffic Manager and Chief Clerk were not wholly employed on Light Railway work.

Two guards were provided by the 25th Company, Sappers and Miners, and one by the 26th Company. Sanitary staff was provided by the Engineering Department. All level-crossing gates were under the Engineering Department.

The European Station-masters were posted at Tis Hazari, Mall and Polo.

The Jemadar of Sappers and Miners was posted at Jaroda and was in general charge of the six stations, VII. Division, to Bhorari Road of which the Sappers and Miners were in charge.

Observations.—Although the staff was such a mixed lot the work they did was surprisingly good. There were few cases of indiscipline or irregularities requiring punishment and the one or two who showed themselves incompetent were at once discharged.

The work done by the party of the 2nd (Q.V.O.) Sappers and Miners was most gratifying. None of them had any previous experience of traffic work, but they turned out in every way satisfactory. The men lent by the North-Western Railway and Oudh and Rohilkhand Railway all did well and were as a rule employed in the stations having the heaviest traffic.

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SIEGES AND THE DEFENCE OF FORTIFIED PLACES BY THE BRITISH AND INDIAN ARMIES IN THE XIXth CENTURY.

(*Continued*).

By COLONEL SIR EDWARD T. THACKERAY, V.C., K.C.B. (LATE R.E.).

SIEGE OF SAN SEBASTIAN, *July*, 1813.

In June, 1813, the Anglo-Portuguese troops were detailed by Lord Wellington to cover the Siege of San Sebastian, and the blockade of Pampeluna, while the Spanish divisions attacked Santona on the coast, and the Castles of Daroca, Morella, and Zaragoza in the interior. Pasages was the only port near the scene of operations suited for the supply of the army, but as it was between the covering and besieging armies, the stores and guns once landed were in danger from every movement of the enemy; the Deba River between San Sebastian and Bilbao was unsuitable for large vessels, and no permanent depôt could be established nearer than Bilbao. At that port therefore, and at St. Auder and Corunna, the great depôts of the army were fixed, the stores being transported to them from the establishments in Portugal. But the French held Santona, their privateers interrupted the communication along the coast of Spain, and American privateers did the same between Lisbon and Corunna. The intercourse between San Sebastian and the ports of France was scarcely molested, while the most urgent remonstrances failed to procure a sufficient naval force on the coast of Biscay. It was in these circumstances that Wellington commenced the Siege of San Sebastian.

This fortress, built on a low sandy isthmus, had the harbour on one side, the river Urumea on the other. Behind it rose the Monte Orgullo, a rugged cone 400 ft. high washed by the ocean, its southern face, covered with batteries and overlooking the town, being cut off from the latter by defensive walls. It was crowned by the small castle of La Mota which was itself commanded at a distance of 1,300 yards by the Monte Olea rising beyond the Urumea. The land front was 350 yards wide, stretching quite across the isthmus, and it consisted of a high curtain or rampart very solidly constructed, strengthened by a lofty casemated flat bastion or cavalier placed in the centre, and by half-bastions at either end. A regular hornwork was pushed out from this front; and 600 yards beyond the hornwork the isthmus was closed by the ridge of San Bartolomeo, at the foot of which stood the suburb of San Martin.

On the opposite side of the Urumea were certain sandy hills called

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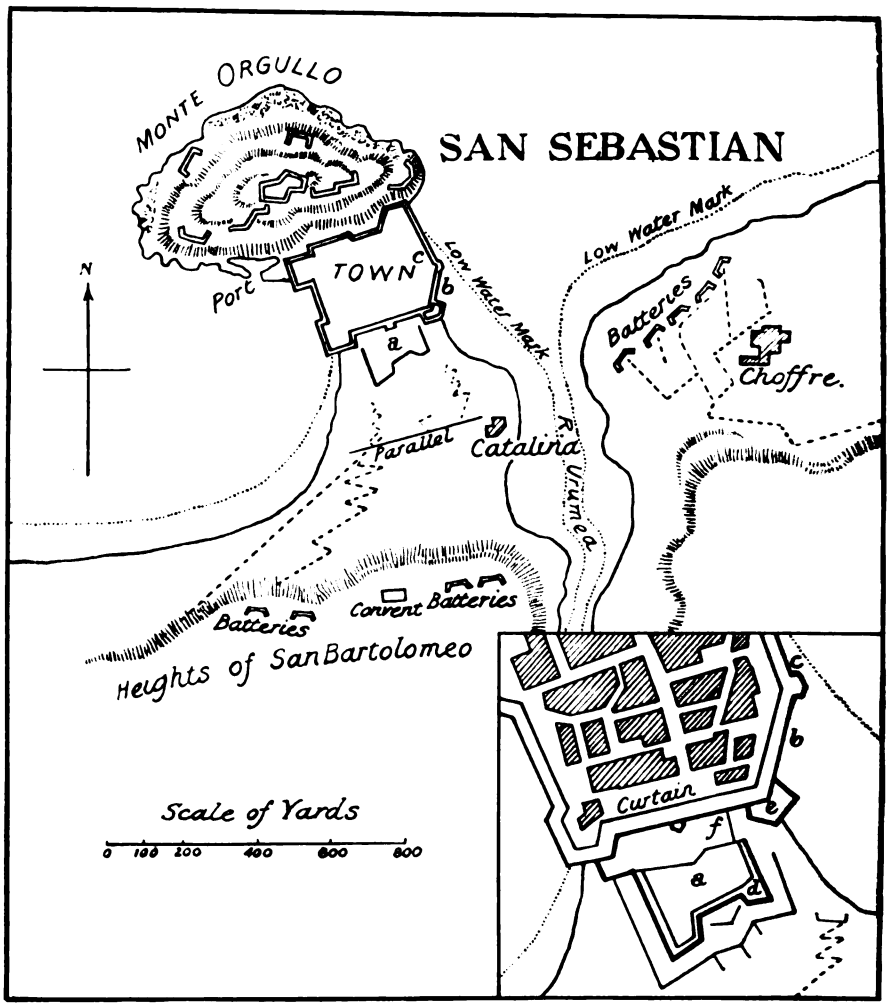

the Choffres, through which the road from Pasages passed to the wooden bridge over the river, and thence by the suburb of Santa Catalina, along the top of a sea wall which formed a *fausse braye* for the hornwork. The flanks of the town were protected by simple ramparts; one washed by the water of the harbour, the other by the Urumea, which at high tide covered four of the 27 ft. of this height of the wall. This was the weak side of the fortress, for though covered by the river there was only a single wall badly flanked by two old towers and the half-bastion of San Elmo, which was situated at the extremity of the rampart close under the Monte Orgullo. There was no ditch, no counterscarp, no glacis; the wall could be seen to its base from the Choffre Hills, at distances varying from 500 to 1,000 yards; and when the tide was out the Urumea left a dry strand

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under the rampart as far as St. Elmo. However the guns from the batteries of Monte Orgullo could cover this strand. The other flank was secured by the harbour, in the mouth of which was a rocky island called Santa Clara, where the French had established a post of a few men.

Before the Battle of Vittoria, San Sebastian was nearly dismantled; many of the guns had been removed to form battering trains or to arm similar ports on the coast, there were no bomb-proofs, palisades, or outworks; the wells were foul, and the place supplied by a single aqueduct. Joseph's defeat restored its importance as a fortress. Emanuel Rey entered it the 22nd June, with the escort of the convoy which quitted Vittoria the day before the battle. The town was then filled with emigrant Spanish families, ministers, and other persons attached to the court; the population ordinarily 8,000, was increased to 16,000 and confusion prevailed. Rey pushed by necessity, immediately forced all persons not residents to march at once to France, granting them a guard of 100 men; the people of quality went by sea, the others by land, and fortunately all arrived for the partidas would have given them no quarter.

Rey then burned the wooden bridge and both the suburbs, and commenced fortifying the heights of San Bartolomeo, which the Spaniards attacked on the 29th and were repulsed.

On the 1st July the Governor of Gueteria abandoned the place and secretly left a lighted train which exploded the magazine and destroyed many of the inhabitants. His troops, 300, entered San Sebastian, and at the same time a vessel from St. Jean de Luz arrived with 56 cannoneers and some workmen, the garrison was thus increased to 3,000 men, and all persons not able to provide sustenance for themselves were ordered to quit the place. On the 3rd the frigate *Surveillante*, with a sloop, and some small craft blockaded the harbour; yet the French vessels from St. Jean de Luz continued to enter by night. The same day the Governor made a sally with 1,100 men to obtain news, and after some hours' skirmishing returned with a few prisoners. On the 9th Graham arrived with a corps of British and Portuguese troops. Before his arrival the French had constructed a redoubt on the heights of San Bartolomeo, and connected it with the convent of that name which they also fortified. These outworks were supported by posts in the ruined houses of San Martin behind, and by a low circular redoubt formed of casks on the main road half-way between the convent and the hornwork. Hence to reduce the place, working along the isthmus it was necessary to carry in succession three lines of defence covering the town, and a fourth at the foot of Monte Orgullo, before the Castle of La Mota could be assailed. These works had 76 pieces mounted, and others were afterwards obtained by sea from France.

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The besieging army consisted of the 5th Division under Oswald, the independent Portuguese brigades of J. Wilson and Bradford, reinforced by detachments from the 1st Division, artillerymen, some seamen commanded by Lieut. O'Reilly of the *Surveillante*, and 100 regular Sappers & Miners (now for the first time used in the sieges of the Peninsular), making in all nearly 10,000 men. There was a new battering train, originally prepared to besiege Burgos, consisting of fourteen iron 24-pounders, six 8-in. brass howitzers, four 68-pound iron carronades, and four iron 10-in. mortars; six 24-pounders lent by the ships of war, and six 18-pounders which had moved from the army from Portugal, making altogether 40 pieces, commanded by Colonel Dickson. The distance from the siege depôt at Pasages to the Choffres was 1½ miles of good road, and a pontoon bridge was thrown over the Urumea River above these hills; but from thence to the height of Bartolomeo there was more than 5 miles of very bad road.

Early in July the fortress had been twice closely inspected by Major Smith, the Engineer who had so ably defended Tarifa. He proposed a plan of siege, founded upon the facility furnished by the Choffres, to destroy the flanks, rake the principal front, and form a breach with the same batteries; the works being at the same time secured, except at low water, by the Urumea. Counter-batteries on the left of that river, were to rake the line of defence in which the breach was to be formed; and against the castle and its outworks he relied principally upon vertical fire. This plan would probably have reduced San Sebastian in a reasonable time without any remarkable loss of men; Wellington approved of it, though he doubted the efficacy of the vertical fire and he ordered the siege to be commenced. Although anxious to save time, he did not urge the Engineer beyond the rules. *Take the place in the quickest manner, yet do not from over-speed fail to take it.*

During the night of the 10th two batteries were commenced against the convent, and the redoubt of San Bartolomeo; and next night four batteries, to contain twenty of the heaviest guns and four 8-in. howitzers, were marked out on the Choffre sandhills, at distances varying from 600 to 1,300 yards from the eastern ramparts of the town. Two attacks were established, one on the right bank of the Urumea for the Portuguese brigades; one on the left bank for the 5th Division.

On the 14th a French sloop entered the harbour with supplies, and the batteries of the left attack opened against San Bartolomeo throwing hot shot into that building. The besieged responded with musketry from the redoubt, with heavy guns from the town, and with a field piece which they had mounted on the belfry of the convent itself. On the 15th Sir Richard Fletcher took command of the Engineers. This day the batteries set the convent on fire,

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silenced the musketry of the besieged, and so damaged the defences that the Portuguese of the 5th Division were ordered to feel the enemy; they were however repulsed with great loss, the French sallied, and the firing did not cease until nightfall.

On the 17th the convent being nearly in ruins, the assault was ordered. The storming party was formed in two columns. Detachments from Wilson's Portuguese, supported by the Light Company of the 9th British Regiment, and three companies of the Royals, under General Hay, were destined to assail the redoubt; General Bradford leading the other column, composed of Portuguese, supported by three companies of the 9th under Colonel Cameron were to assail the convent.

Assault of San Bartolomeo.

At 10 o'clock in the morning two heavy 6-pounders opened against the redoubt, and a sharp musketry fire from the French, announced their resolution to fight. The allied troops were assembled behind the crest of the hill overlooking the convent, and the first signal was given; but the Portuguese advanced so slowly at both attacks that the supporting columns of the 9th Regiment, passing through them, fell upon the enemy with the usual impetuosity of British soldiers. Cameron leading his grenadiers downhill was exposed to a heavy cannonade from the hornwork, but he gained the cover of a wall 50 yards from the convent and there awaited the second signal. His rapid advance, which threatened to cut off the garrison from the suburb, caused the French to abandon the redoubt; Cameron's force then cleared the wall and assaulted both the convent and the houses of the suburb. At the latter a fierce struggle ensued and Capt. Woodham of the 9th was killed in the upper room of a house, but the grenadiers carried the convent with such rapidity that the French unable to explode some small mines, hastily joined the troops in the suburb. There the fighting continued, and the affair was becoming doubtful, when the remaining companies of the 9th Regiment arrived, and the suburb with much fighting was won. At the right attack the company of the 9th though retarded by a ravine, a thick hedge, the slowness of the Portuguese, and a heavy fire, entered the abandoned redoubt with little loss; but all the troops were then, contrary to Oswald's orders, rashly led against the cask redoubt, and were beaten back by the enemy. The French lost 240 men. On the British side the companies of the 9th under Cameron alone lost 7 officers and 60 men killed or wounded and the whole operation though successful was an error. The battery on the Urumea was not opened, so that either the assault was precipitated or the battery was not necessary, but the loss justified the conception of the battery.

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When the action ceased, the Engineers made a lodgment in the redoubt ; and commenced two batteries for eight pieces to rake the hornwork and the eastern rampart of the place. Two other batteries, to contain four 68-pounder carronades and four 10-in. mortars, were also commenced on the right bank of the Urumea. The besieged then threw up traverses on the land front to meet the raking fire of the besiegers, and the latter dragged four pieces up the Monte Olea to fire into the Mirador and other batteries on the Monte Orgullo. During the night a lodgment was made on the ruins of San Martin ; the batteries at the right attack were armed, and two additional mortars dragged up the Monte Olea ; on the 19th all the batteries of both attacks were armed, and that night two approaches were commenced from the suburb towards the cask redoubt, from whence the French were driven.

On the 20th the whole of the batteries opened fire, the greatest part being directed to form the breach.

Smith's plan was similar to that followed by Marshal Beresford a century before. He proposed a lodgment on the hornwork before the breach should be assailed, but he unknowingly fixed the breaching point precisely where the wall had been most strongly rebuilt after Berwick's attack. This was the first fault, yet a slight one, because the wall did not resist the batteries very long ; it was a more serious matter that Graham, at the suggestion of the commander of the artillery, began his operations by breaching. Smith was opposed to it, but Fletcher acquiesced reluctantly, on the understanding that the destruction of the defences was only postponed, an understanding afterwards forgotten.

The result of the first day's firing was not satisfactory. The weather was bad, the guns mounted on ship carriages failed, one 24-pounder was rendered unserviceable by the enemy, another useless by an accident, a captain of Engineers was killed, and the besiegers' shot had little effect upon the solid wall. During the night however the ship guns were mounted on better carriages, and a parallel across the isthmus was projected, but the greater part of the workmen sought shelter in the suburb of San Martin, and when day broke only one-third of the work was performed.

On the 21st the place was summoned, but the Governor refused to receive the letter, and the firing was resumed. The main wall still resisted, yet the parapets and embrasures crumbled away, and the batteries on Monte Olea plunged their fire into the hornwork, with such effect, although at 1,600 yards distance, that the besieged having no bombproofs were forced to dig trenches to protect themselves. The counter-fire directed solely against the breaching batteries was feeble, but at midnight a shell thrown from the castle into the bay gave the signal for a sally, and during the fire which ensued several French vessels with supplies entered the

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harbour. This night the besieged also isolated the breach by cuts in the rampart and other defences. On the other hand the besiegers' parallel across the isthmus was completed, and in its progress laid bare the mouth of a drain, 4 ft. high and 3 ft. wide, containing the pipe of the aqueduct cut off by the Spaniards. Through this narrow opening Lieut. Reid of the Engineers, a young and zealous officer, crept as far as the counterscarp of the hornwork, but there finding the passage closed by a door returned without an accident. Thirty barrels of powder were then placed in the drain, 8 ft. being stopped with sandbags to form a globe of compression, which was designed to blow sufficient rubbish over the counterscarp to fill the narrow ditch of the hornwork.

On the 22nd the fire from the batteries, unexampled by its rapidity and accuracy, opened what appeared to the besiegers a very practicable breach in the eastern flank wall. The counter-fire of the besiegers then slackened, yet the descent into the town from the breach was more than 12 ft. perpendicular, and the garrison was seen from Monte Olea diligently working at the interior defences to receive the assault. The besiegers now placed four 68-pound carronades in battery to play on the defences of the breach, but the general fire slackened because the guns were greatly enlarged at the vents with constant firing.

On the 23rd, the sea blockade being null, the French vessels returned to France with the badly wounded men; and that day the besiegers judging the breach between the towers quite practicable, turned the guns to break the wall on the right of the main breach. Smith opposed this, urging that no advantage would be gained by opening a second opening to get to which the troops must first pass the great breach, that time would be lost to the besiegers, and there was a manifest objection on account of the tide and the depth of water at the new point attacked. His counsel was overruled and in the course of the day, the wall being thin and the fire heavy and quick, a second breach 30 ft. wide was rendered practicable. Then the fire of the besieged being much diminished, the 10-in. mortars and 68-pound carronades were turned upon the defences of the great breach. The nearest houses were soon in flames which spreading rapidly destroyed some of the defences, and menaced the whole town with destruction, and the assault was ordered for the next morning; but when the troops assembled the burning houses appeared so formidable that the attack was deferred. The batteries then fired again, partly on the second breach, partly on the defences, partly to break the wall in a third place between the half-bastion of St. John on the land front and the main breach.

During the night the vigilant Governor mounted two fieldpieces on the cavalier in the centre of the land front, and he still had on

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the hornwork a light piece, and two casemated guns on the flank of the cavalier. Two other field pieces were mounted on an entrenchment, and a 24-pounder looked from the Tower of Las Mesquitas; two 4-pounders were in the Tower of Hornos, two heavy guns were on the flank of St. Elmo, and two others placed on the right of the Mirador.

Thus 14 pieces were still available for defence, the retaining sea wall, or *fausse braye*, which strengthened the Urumea flank of the hornwork and between which and the river the storming parties must necessarily advance, was covered with live shells to roll over on the columns, and behind the flaming houses near the breach other edifices were loopholed and filled with musketeers. However the fire extended rapidly and fiercely, greatly injuring the defences; the French withdrew their guns until the moment of attack, while the British artillery officers declared they could silence the enemy's fire in daylight, and keep the parapet clear of men Graham thereupon renewed the order for

The Assault.

During the night of the 24th 2,000 men of the 5th Division filed into the trenches on the isthmus. This force was composed of the 3rd Battalion of the Royals under Major Fraser, detailed to storm the great breach; the 38th Regiment under Colonel Greville for assailing the lesser and most distant breach; and the 9th Regiment under Colonel Cameron, to support the Royals. A detachment selected from the Light Companies of all these battalions was placed in the centre of the Royals under the command of Lieut. Campbell of the 9th Regiment; he was accompanied by Lieut. L. Machell of the Engineers and a ladder party and was to sweep the high curtain after the breach should be won.

From the trenches to the point of attack was more than 300 yards along a contracted space, the ground was strewed with rocks covered by slippery seaweed, the tide had left large and deep pools of water—the parapet of the hornwork was entire as well as the retaining wall—the parapets of the other works and the two towers which closely flanked the breach, although injured were far from being ruined, and the walls and defences were fully manned. The difficulties indeed were obvious.

While it was still dark the storming columns moved out of the trenches, and the mine in the drain was exploded against the counterscarp and glacis of the hornwork with great effect. The garrison astonished by this unlooked for event abandoned the flanking parapet, and the Allies rushed onwards, the storming party for the main breach leading and suffering more from the fire of the batteries on the right of the Urumea, than from the enemy. Major Fraser and Lieut. Harry Jones of the Engineers first reached the breach, and as the

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enemy had fallen back in confusion behind the ruins of the burning houses, those brave officers rushed up expecting that their troops would follow, but not many did for it was extremely dark, and the natural difficulties of the way had contracted the front and disordered the column in its whole length, the soldiers, straggling and out of wind, arrived in small disconnected parties at the foot of the breach. The foremost gathered near their gallant leaders, but the depth of the descent into the town, and the volumes of flame and smoke which still issued from the burning houses behind awed the stoutest, and more than two-thirds of the column harassed by the flank fire, had broken off at the demi-bastion to commence a musketry combat with the enemy on the ramparts.

Meanwhile the shells from the Monte Orgullo fell rapidly, the French rallied and with a smashing musketry from the ruins and loopholed houses assailed the head of the stormers, while the men in the towers took them on the flank; and from every quarter came showers of grape and hand grenades, shattering them in a terrible manner.

Fraser was killed on the flaming ruins, the intrepid Jones stood there a while longer amid a few heroic soldiers, hoping for aid, but none came, and he and those with him were struck down; Lieut. Machell was killed early, and the ladder bearers fell or were dispersed. Thus the rear of the column was in confusion before the head was beaten, and it was in vain that Greville of the 38th, Cameron of the 9th, and many other regimental officers attempted to rally their discomfited troops and refill the breach; it was in vain that Lieut. Campbell breaking through the tumultuous crowd with the survivors of his chosen detachment, mounted the ruins—twice he ascended, twice he was wounded, and all around him died. The Royals endeavouring to retire, got intermixed with the 38th and with some of the 9th, who had unsuccessfully tried to pass them and get to the lesser breach. Then swayed by different impulses, pent up in the narrow way between the hornwork and the river, the mass reeling to and fro could neither advance or retire until the shells and musketry, constantly plied both in front and flank, had thinned the concourse when the trenches were regained in confusion. At daybreak a truce was agreed to for an hour, during which the French, who had already recovered the gallant Jones and some of the wounded men from the breach, carried off the more distant sufferers lest they should be drowned by the rising of the tide; but during the contest some grenadiers rushed out of the breach and stabbed several wounded soldiers lying there.

Five officers of the Engineers including Sir Richard Fletcher, and 44 officers of the Line with 520 men, had been killed, wounded, or

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taken prisoners in this assault, the failure of which was signal. The causes were obvious and may be classed thus :—

1st. Deviation from the original project of siege and from Wellington's instructions.

2nd. Bad arrangements of detail.

3rd. Want of vigour in the execution.

Wellington having visited the Choffre trenches on the 22nd had confirmed his first approval of Smith's plan, and gave that officer final directions for the attack finishing thus "*Fair daylight must be taken for the assault.*" These instructions were repeated by Smith in the proper quarter, and were not followed; no lodgment was made on the hornwork, the defences were nearly entire both in front and flank, and the assault was given in darkness. Smith had ascertained by calculation and consultations with the fishermen, that the ebb of tide would serve exactly at daybreak on the 24th; yet the assault was only made the 25th and before daylight, when the high water, contracting the ground, increased the obstacles and forced the assaulting column to march in a narrow front and a long line, thus making a difficult progress. The rules of art being thus neglected the operation failed.

During the night the troops filed out of the long narrow trenches, a tedious operation, and were at once exposed to a fire of grape from their own batteries on the Choffres. This fire should have ceased when the mine was sprung, but owing to the darkness and noise the latter was neither seen nor heard, and though the Portuguese advanced to the ditch, where a vigorous escalade would probably have succeeded, they had no ladders. The stormers of the great breach marched first filling up the way, and rendering the second breach, as Smith had foretold, useless, and the ladder bearers never got to their destination.

There was also a neglect of moral influence. Deferring the assault from the 24th to the 25th, expressly because the breach was too difficult, rendered the troops uneasy; they suspected hidden danger. In this mood emerging from the trenches they were struck by the fire of their own batteries; and then wading through deep pools of water, or staggering over slippery rocks, and being close under the enemy's flanking works where every shot told with fatal effect, how could they succeed? A second and more vigorous assault on the great breach might have been effected by a recognized leader; but no general or staff officer went out of the trenches, and the isolated exertions of the regimental officers failed.

Wellington repaired immediately to San Sebastian. The causes of failure were apparent, and he would have renewed the attack, but was compelled from want of ammunition to defer it, until powder and additional ordnance, should arrive. Next day other events caused him to resort to a blockade, and the battering train was

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transported to Pasages, two guns and two howitzers only being retained on the Choffre and Monte Olea. This operation was completed during the night of the 26th, but at daybreak the garrison made a sally from the hornwork, surprised the trenches and swept off 200 Portuguese and 30 British soldiers. To avoid a repetition of this disaster the guards of the trenches were concentrated in the left parallel, and patrols only were sent out, but one of these also was cut off on the 1st August. Thus terminated the first part of the Siege of San Sebastian in which the Allies lost 1,300 soldiers and seamen, exclusive of Spaniards during Mendizabel's blockade.

Renewed Siege of San Sebastian.

Villette's demonstration against Louga on the 28th July had caused the ships laden with the battery train to put to sea, but on the 5th August the guns were re-landed and the works against the fortress resumed.

The old trenches were repaired, the heights of San Bartolomeo were strengthened, and the Convent of Antigua, built on a rock to the left of those heights, was fortified and armed with two guns to scour the open beach and sweep the bay. The siege however languished for want of ammunition ; and during this forced inactivity the garrison received supplies and reinforcements by sea, repaired their damaged works, made new defences, filled their magazines, and put 67 pieces of artillery in a condition to fire. Eight hundred and fifty men had been killed or wounded since the commencement of the attack in July ; but fresh men came by sea, and more than 2,600 good soldiers were still present under arms.

However the general firing was severe upon the castle and the town works and the defences were damaged ; the French guns were nearly silenced, additional mortars were mounted at the Choffre, making in all 63 pieces of which 29 threw shells, and the superiority of the besiegers was established. Now however the Urumea was discovered to be fordable by Capt. Alexander Macdonald of the Artillery, who had waded across in the night, and passed close under the works to the breach. A few minutes would suffice to bring the enemy into the Choffre batteries, and therefore to save the guns from being spiked their vents were covered at night with iron plates fastened by chains.

This day the materials and ordnance for six pieces, to take the defences of the Monte Orgullo in reverse, were sent to the island of Santa Clara ; and from the Choffre some guns played on the retaining wall of the hornwork ; but with low charges to shake down any mines constructed there without destroying the wall itself, which offered cover for troops in an assault. The trenches at the isthmus were now wide and good, the sap was pushed close to the hornwork ; and

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the sea wall, supporting the high road into the town, which had in the first assault lengthened the run and cramped the columns, was broken through to give access to the strand and shorten the approach to the breaches. The crisis was now at hand, and during the night of the 29th a false attack was ordered, to make the enemy spring his mines. This desperate service was executed by Lieut. Macadam of the 9th Regiment; the order was sudden and no volunteers were demanded, no rewards offered, no means of excitement resorted to; yet such is the inherent bravery of British soldiers, that 17 men of the Royals, the nearest at hand, immediately leaped forth ready and willing to encounter what seemed certain death. With a rapid pace, all the breaching batteries firing hotly at the time, they reached the foot of the breach unperceived, and then mounted in extended order shouting and firing; the French were too steady to be imposed upon, their musketry laid the party low, and their commander returned nearly alone to the trenches.

On the 30th the sea flank being open from the half-bastion of St. John to the most distant of the old breaches, 500 ft., the Choffre batteries were turned against the castle and the other defences of the Monte Orgullo. The battery on the isthmus in conjunction with the fire from the Choffre, also demolished the face of the St. John's Bastion and the end of the high curtain above it; thus the whole of that quarter was in ruins. The San Bartolomeo batteries then broke the demi-bastion of the hornwork, and Wellington after examining the defences decided to make a lodgment and ordered the assault for the following day at 11 o'clock, when the ebb of the tide would leave space between the hornwork and the water. The galleries in front of the advanced batteries on the isthmus were now pushed to the sea wall; and three mines were formed with the double view of opening a way for the troops to reach the strand, thus rendering useless any subterranean works the enemy might have made in that part. At 2 o'clock on the morning of the 31st they were sprung, and opened three wide passages; these were immediately connected, and a traverse of gabions, 6 ft. high, was run across the mouth of the main trench on the left, to screen the opening from the grape shot of the castle. Everything was now ready for the assault, but before describing that terrible event it will be fitting to show the exact state of the besieged in defence.

Graham had been before the place for 52 days, during 30 of which the attack was suspended. All this time the garrison had laboured incessantly; and though the besiegers' fire appeared to have ruined the defences of the enormous breach in the sea flank such was not the case. A perpendicular fall behind of more than 20 ft. barred progress; and beyond, amongst the ruins of the burnt houses, was a strong counter-wall 15 ft. high, loopholed for musketry and parallel with the breaches, which were also cut off from the sound part of the rampart

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by traverses at the extremities. To evince their confidence, the besieged celebrated the Emperor's birthday by crowning the castle with a splendid illumination, encircling it with a fiery legend to his honour in characters so large as to be distinctly read by the besiegers.

On the 19th after a delay of 16 days the battering train arrived from England, and 15 heavy pieces were placed in battery, 8 at the right attack, 7 at the left during the night of the 22nd. A second battering train came on the 23rd augmenting the number of pieces of various kinds to 117, but with characteristic negligence this enormous armament had been sent out from England with no more shot and shell than would suffice for one day's consumption.

In the night of the 23rd the batteries on the Choffre were reinforced with four long pieces and four 68-pound carronades; the left attack had six additional guns. Ninety sappers & miners had come with the train from England, the seamen under Lieut. O'Reilly were again attached to the batteries, and part of the field artillerymen were brought to the siege. The Choffre batteries were also enlarged to contain 48 pieces, and two batteries for 13 pieces were begun on the heights of Bartolomeo. These last were to breach at 700 yards distance the faces of the left demi-bastion of the hornwork, that of St. John on the main front, and the end of the high curtain; for these works rising in gradation one above the other, were in the same line of fire. The approaches by the isthmus were pushed forward by sap, but the old trenches were still imperfect; and before daylight on the 25th, the French coming from the hornwork, swept the left of the parallel, injured the sap, and made some prisoners.

On the night of the the 25th, the batteries were all armed on both sides of the Urumea, and on the 26th 57 pieces opening with a general salvo, continued to play with astounding noise and rapidity until evening. The fire from the Choffre Hills destroyed the revetment of the demi-bastion of St. John, and nearly ruined the towers at the old breach together with the wall connecting them; but at the isthmus the batteries, although they injured the hornwork, made little impression on the main front, from which they were too far distant.

Wellington, present at this attack and discontented with the operation, then ordered a battery for six guns to be constructed amongst some ruined houses on the right of the parallel, 300 yards from the main front. Two shafts were also sunk with a view to drive galleries for its protection against the enemy's mines; but the sandy soil made this work slow.

Early on the 27th the boats of the squadron under Lieut. Arbuthnot of the *Surveillante*, carrying 100 men of the 9th Regiment under Capt. Cameron, attacked the island of Santa Clara. The troops landed with some difficulty under a heavy fire, but a lodgment was made with the loss of only 28 officers and men, of whom 18 were seamen.

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In the night the French sallied against the new battery on the isthmus; but were met with the bayonet by men of the 9th Regiment under Colonel Cameron on the very edge of the trenches. The attempt failed but it delayed the arming of the battery. At daybreak the renewed fire of the besiegers was extremely heavy, and the shrapnel shell were supposed to be very destructive; but the practice with that missile was uncertain, the bullets frequently flew amongst the guards in the parallel and one struck the field officer. In the course of the day another sally was commenced, but the enemy being fired upon did not persist. The trenches were now furnished with banquettes and parapets as fast as the quantity of gabions and fascines would permit; but the work was slow because the Spanish authorities neglected to provide carts to convey the materials from the woods, and this hard labour was performed by Portuguese soldiers.

Wellington visited the works again, and the advanced battery was armed with four guns and opened next morning; but an accident prevented the arrival of one gun, the enemy dismounted another, and only two instead of six guns as Wellington had designed, smote the demi-bastion of St John, and the end of the high curtain.

The only really practicable way into the town was by the narrow end of the high curtain above the half-bastion of St. John. About the middle of the great breach stood the Tower of Los Hornos, still capable of some defence, and beneath it a mine charged with 12 cwt. of powder. The streets were all trenched and furnished with traverses to dispute the passage and cover the retreat to the Monte Orgullo; to reach the main breach it was also necessary to form a lodgment in the hornwork, or pass as in the former assault, under a flanking fire of musketry for 200 yards; and the first step was close under the sea wall at the salient angle of the covered way, where two mines charged with 800 lbs. of powder were prepared.

Besides these retrenchments and mines, the French had still some artillery in reserve. One 16-pounder mounted at St. Elmo flanked the left of the breaches on the river face; a 12 and an 8-pounder, preserved in the casemates of the cavalier, were ready to flank the land face of the half-bastion of St. John; many guns from the Monte Orgullo could play upon the columns, and there was a 4-pounder hidden on the hornwork to be brought into action when the assault commenced. Neither the resolution of the Governor or the courage of the garrison was abated; but the overwhelming fire of the past few days had reduced the number of fighting men; and Rey who had only 250 men in reserve, demanded of Soult whether his brave garrison should be exposed to another assault. "The army would endeavour to succour him" was the reply, and he abided his fate.

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Storming of San Sebastian.

To assault the breaches without having destroyed the enemy's defences, or established a lodgment on the hornwork, notwithstanding the increased fire and greater facilities of the besiegers, was obviously a repetition of error. And the same generals who had before publicly disapproved of such operations, now more freely dealt out censures, not ill-founded, but very indiscreet since there is much danger when doubts expressed by their commanders reach the men. Wellington thought the 5th Division had been thus discouraged. He was incensed and demanded 50 volunteers from each of the 15 regiments composing the 1st, 4th, and Light Divisions, "*men who could show other troops how to mount a breach.*" Such was the phrase employed, and 750 gallant soldiers instantly marched to San Sebastian in answer to the appeal. Colonel Cooke and Major Robertson led the Guards and Germans of the 1st Division; Major Rose commanded the men of the 4th Division; Colonel Hunt, who had already earned his promotion at former assaults, was at the head of the fierce rugged veterans of the Light Division; yet there were good officers and brave soldiers in the 5th Division.

It being at first supposed that Wellington designed only a simple lodgment on the great breach, the volunteers and one brigade of the 5th Division only were ordered to be ready; but at a council held at night, Major Smith maintained that the orders had been misunderstood, as no lodgment could be formed until the high curtain was gained. General Oswald, being called to the council, was of the same opinion; whereupon the remainder of the 5th Division was brought to the trenches; and General Bradford having offered the services of his Portuguese brigade, was told he might ford the Urumea and assail the farthest breach if he thought it advisable.

Leith had now resumed command of the 5th Division, and directed the attack from the isthmus; but he was extremely offended with the volunteers, and would not allow them to lead the assault; some he spread along the trenches to keep down the fire of the hornwork, the remainder was held in reserve with Hay's British and Sprye's Portuguese brigades of the 5th Division. To Robertson's brigade the assault was confided; it was formed in two columns, one to attack the old breach between the towers, the other to storm the bastion of St. John and the end of the high curtain. The small breach on the extreme right was left for Bradford's Portuguese, who were on the Choffre Hills; some large boats filled with troops were directed to make a demonstration against the sea line of the Monte Orgullo, and Graham overlooked the whole operations from the right bank of the river.

Heavily the morning of the 31st broke, a thick fog hid every object and the besiegers' batteries could not open until 8 o'clock;

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from that hour however a constant shower of missiles was poured upon the besiegers until 11, when Robertson's brigade quitted the trenches, and passing through the openings in the sea wall was launched against the breaches. While the head of this column was still gathering on the strand, 30 yards from the salient angle of the hornworks, 12 men under a sergeant, whose heroic death has not sufficed to preserve his name, rushing forward leaped upon the covered way with intent to destroy the enemy's mines. The French startled by this sudden assault fired the train prematurely; but though the sergeant and his followers were all destroyed and the high sea wall thrown with a dreadful crash upon the head of the advancing column, not more than 40 men were crushed by the ruins, and the rush of the troops was scarcely checked. The Forlorn Hope had before passed beyond the play of the mine, and now hurried along the strand amidst a shower of grape and shells, the leader, Lieut. Macquire, of the 4th Regiment, conspicuous by his long white plume, his fine figure and his dash, bounding far ahead of his men in all the pride of youthful strength and courage; but at the foot of the great breach he fell dead, and the stormers swept over his body, many died however with him, and the passage of wounded men to the rear was incessant.

This time there was a broad strand left by the retreating tide, and the sun had dried the rocks, but the latter still disturbed the order and closeness of the formation, and the main breach was 200 yards distant. The French seeing the first mass pass the hornwork, regardless of its broken bastion, crowded to the river face and poured their musketry into the second column as it rushed along a few yards below them; but the English returned this fire without slackening their speed. Then the batteries of Monte Orgullo and the St. Elmo sent down showers of shot and shell, the two pieces on the cavalier swept the face of the breach in St. John, the 4-pounder mounted in the hornwork was suddenly mounted on the broken bastion and poured grape shot into the rear. Thus scourged with fire from all sides, their array broken alike by the shot and by the rocks they passed over, the troops reached their destination. The first column soon reached the top of the great breach, but the unexpected gulf below could only be passed at a few places, and the deadly French muskets clattering from the loophole and wall beyond, strewed the crest of the ruins with dead. In vain the following multitude, covering the ascent, sought entrance at every part; to advance was impossible and slowly sinking downwards the mass remained stubborn and immovable on the lower part of the breach. There they were safe from the musketry in front; but from isolated points, especially from Los Hornos under which the great mine was placed, the French still assailed them with small arms, and from Monte Orgullo came shells and grape without intermission.

At the half-bastion of St. John the access to the top of the high

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curtain being quite practicable, the efforts to force a way were more persevering and constant, and the slaughter was in proportion, for the traverse on the flank was defended by French grenadiers who would not yield. The two pieces on the cavalier itself swept the front of the opening, and the 4-pounder and musketry from the hornwork swept the river face.

Some Sappers and a working party attached to the assaulting columns endeavoured to form a lodgment; but no artificial materials had been provided, and most of the labourers were killed before they could form the loose rocky fragments into a cover. During this time the counter-fire of the British artillery killed many; and the reserve brigades of the 5th Division were pushed on by degrees to feed the attack, until the left wing of the 9th Regiment only remained in the trenches. The volunteers, who had been with difficulty restrained in the trenches, called out to know why they had been brought there if they were not to lead the assault. These men who had given such offence to Leith that he would have kept them altogether from the assault, being now let loose went like a whirlwind to the breaches and the crowded masses swarmed up the face of the ruins; but on reaching the crest line they came down again like a falling wall, crowd after crowd were seen to mount, to totter, to sink, the French fire was unabated, the smoke floated away, and the crest of the breach bore no living man!

Graham standing on the nearest of the Choffre batteries, beheld this frightful destruction with a stern resolution to win at any cost; and he was a man to have put himself at the head of the last company and die sword in hand upon the breach, rather than sustain a second defeat; and neither his confidence nor his resources were exhausted. He directed an attempt to be made on the hornwork, and turned all the Choffre batteries and one on the isthmus, that is to say the concentrated fire of 50 heavy pieces upon the high curtain. The shot ranged over the heads of the troops now gathered at the foot of the breach; and the stream of missiles thus poured along the upper surface broke down the traverses and in its fearful course, shattering all things, strewed the ramparts with the bodies of the defenders. When this flight of shot first swept over the heads of the soldiers a cry arose from some inexperienced people "to retire because the batteries were firing upon the stormers"; but the veterans of the Light Division under Hunt were not men to be so disturbed; and in the very heat and fury of the cannonade they effected a solid lodgment in some ruins of houses actually within the rampart on the right of the great breach.

For half an hour this horrid tempest smote against the works and the houses behind; and when it ceased the clatter of the French muskets showed that the fight was renewed. At this time also the 13th Portuguese Regiment, led by Major Snodgrass, and followed by a detachment of the 24th under Colonel Macbean, entered

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the river from the Choffre. The ford was deep, the water rose above the waist, and when the soldiers reached the middle of the stream which was 200 yards wide, a heavy gun struck the head of the column with a shower of grape, the havoc was fearful but the survivors closed up and moved on. A second discharge from the same piece tore the ranks from front to rear, still the regiment moved on, and amidst a confused fire of musketry from the ramparts and of artillery from St. Elmo, from the castle and from the Mirador, landed on the left bank and rushed against the third breach. Macbean's men following with equal bravery reinforced the great breach 80 yards to the left of the other, although the line of ruins seemed to extend the whole way.

Then the fighting became fierce and obstinate again at all the breaches; but the French musketry still rolled with deadly effect, the heaps of slain increased, and once more the great mass of the stormers sunk to the foot of the ruins unable to win; the living sheltered themselves as they could, and the dead and wounded lay so thickly that it could hardly be judged whether the injured or uninjured were the most numerous.

It was now evident that the assault must fail unless some accident happened; for the tide was rising, the reserves all engaged, and no greater effect could be expected from men whose courage had been already pushed to the verge of madness. In this crisis fortune intervened. A number of powder barrels, live shells, and combustible materials which the French had accumulated behind the traverses for their defence, caught fire. Soon a bright consuming flame wrapped the whole of the high curtain, a succession of loud explosions were heard, hundreds of the French grenadiers were destroyed, the rest were thrown into confusion; and while the ramparts were still enveloped with suffocating eddies of smoke, the British soldiers broke in at the first traverse. The defenders bewildered by this terrible disaster, yielded for a moment, but some rallied and a close desperate struggle took place along the summit of the high curtain; the fury of the stormers, whose numbers increased every moment, could however not be stemmed. The French colours on the cavalier were torn away by Lieut. Gethin, of the 11th Regiment; the hornwork, the land front below the curtain, the loopholed wall behind the great breach were all abandoned; the soldiers of the Light Division who had already established themselves in the ruins on the French left, penetrated to the streets, and the Portuguese at the small breach mixed with British who had wandered to that point seeking for an entrance, burst in on their side.

Five hours the dreadful battle had lasted at the walls, and now the stream of war went pouring into the town. The undaunted Governor still disputed the victory for a short time with the aid of his barricades; but several hundreds of his men were cut off and taken in the hornwork, and even to effect a retreat behind the line

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of defences which separated the town from the Monte Orgullo was difficult; however a crowd of his troops flying from the hornwork along the harbour flank of the town, broke through a body of the British which had reached the vicinity of the fortified convent of Santa Téresa. This post was the only one retained by the French in the town, and it was thought that Monte Orgullo might have been carried, if a general to direct the troops had been at hand; but whether from wounds or accident no officer of that rank entered the place until long after the breach had been won; the battalion chiefs were thus embarrassed for want of orders, and a thunderstorm coming down from the mountains with unbounded fury immediately after the place was carried, added to the confusion of the fight.

The capture of the town was marked with much violence and brutality and although many officers exerted themselves to preserve order, and many men were well conducted, the rapine and violence commenced by villains spread; the camp followers soon crowded into the place, and the disorder continued until the flames following the steps of the plunderer, put an end to his ferocity by destroying the whole town. Three generals, Leith, Oswald, and Robinson, had been wounded in the trenches; Sir Richard Fletcher, Chief Engineer, a brave man who had long served his country honourably, was killed; Colonel* Burgoyne, Second Engineer, was wounded, and the carnage at the breaches was appalling. The volunteers though brought late into action had nearly half their number struck down; most of the regiments of the 5th Division suffered in the same proportion, and the whole loss since the renewal of the siege exceeded 2,500 officers and men.

When the town was taken the steep and rugged Monte Orgullo with its citadel remained to be assailed. It presented four batteries connected with masonry in first line; and from the extremities ramps protected by redans led to the Santa Téresa Convent, which offered a salient point of defence. On the side facing Santa Clara, and behind the Orgullo were some sea batteries, and if all these works had been of good construction and guarded by fresh troops, the second siege would have been difficult. But the force of the garrison was shattered by the recent assault, most of the Engineers had been killed, the Governor and many others wounded, 500 men were sick or hurt, the soldiers fit for duty did not exceed 1,300, and they had 400 prisoners to guard.

The castle was small, the bombproofs scarcely sufficed to protect the ammunition and provisions, and only ten guns remained in a condition for service, three of which were on the sea line. There was very little water, and the troops had to lie out on the naked rock, exposed to fire, or only covered by inequalities of ground; Rey and his brave garrison were however resolute to fight, and they received

* Afterwards Field Marshal Sir John Burgoyne, G.C.B.

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nightly by sea small supplies of ammunition. Wellington arrived the day after the assault. Regular approaches could not be carried up the steep naked rock, he doubted the power of vertical fire, and ordered batteries to be formed on the captured works of the town, intending to breach the enemy's remaining lines of defence, and then storm the Orgullo. Meanwhile seeing the Santa Téresa would enable the French to sally by the rampart on the left of the Allies, he composed his first line with a few troops strongly barricaded, and placed a supporting body in the market place with strong reserves on the high curtain and flank ramparts. But from the convent, which was actually in the town, the enemy killed many of the besiegers; and when after several days it was assaulted, they set the lower parts on fire and retired by a communication made from the roof to a ramp on the hill behind. All this time the flames were licking up the houses, and the Orgullo was overwhelmed with a vertical fire of shells.

On the 3rd September the Governor was summoned but his resolution was not to be shaken, and the vertical fire was therefore continued day and night. The British prisoners suffered as well as the enemy; for the officer commanding in the castle irritated by the misery of the garrison, cruelly refused to let the unfortunate captives make trenches to cover themselves. The French complained that their wounded and sick men lying in an empty magazine with a black flag flying, and having the English prisoners with their red uniforms placed around to strengthen the claim of humanity, were fired upon.

Guns for the new batteries were now brought, by night, from the Choffre across the Urumea; but the difficulty of struggling with the water in the darkness was great and transport by day was carried out although within reach of the French batteries which fortunately did not fire. The flaming houses impeded the works, but the river furnished cover for marksmen to gall the French, and the guns on Santa Clara were augmented and worked by seamen. With the besieged, ammunition was scarce, the vertical fire subdued their energy, and the besiegers laboured freely until the 8th, then 59 heavy pieces opened at once from the island, the isthmus, and the hornwork, and the Choffre, and in two hours the Mirador and the Queen's battery were broken, the French fire extinguished, the hill torn and furrowed in a frightful manner; the bread ovens were destroyed, a magazine exploded, and the castle crowded with men was overlaid with the falling shells. Then the Governor proudly bending to fate surrendered. On the 9th this brave man and the garrison reduced in number, and leaving 500 wounded in the hospital, marched out with the honours of war. The Spanish flag was hoisted under a salute of 21 guns, and the siege terminated after 63 days of open trenches, just when the tempestuous season commencing would have rendered a continuance of the sea blockade impossible.

(To be continued).

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TRANSCRIPTS.

THE SIEGE OF ADRIANOPLE.

From an article by V. N. Polyanski, in the September, 1913, and subsequent numbers of *Injenerni Jurnal.*

(*Continued*).

CHAPTER IV.

THE ASSAULT AND CAPTURE OF THE FORTRESS, 23RD—25TH MARCH, 1913.

The writer commences this chapter with an apology that he is unable to vouch for the absolute accuracy of everything included in it. The Bulgarian official accounts spoke very little of the actions of the Allies and he was unable to obtain the Servian ones, as they had not yet been edited by the " supreme authority." The data from which this chapter was compiled were the written and verbal accounts of credible witnesses of the events, and the comparison of the various information in conjunction with a personal inspection of the battlefields.

On the 12th March the comparatively fine weather commenced and the re-grouping of the heavy artillery, which had been going on for two months, was completed. If therefore it is asked whether the Allies could not have assaulted the fortress *on its East Front* at an earlier date, it may be replied that the utmost possible difference could only have been that of a few days.

Included in the careful preparations for the assault was the *selection of a commandant* for the most important (East) Front, who must be a suitable man, combining in himself a strong will and resolute character, with knowledge and skill in arranging all technical details and in disposing of all units in the attack. The man selected was Engineer Major-General Vazov, a graduate of the St. Petersburg Nikolaev Academy, who fully justified the confidence reposed in him. He took the most important share in the working out of all the details of the preparation, and to him belongs the honour of the success obtained. It may here be mentioned that in order to keep the date chosen for the assault a complete secret, not only from the Turks but also from the Allies' own troops, for some days previous to it General Vazov was apparently allowed to be away on leave, and a notification to that effect had been published in orders.

In view of the fact that there existed between the Commander of the Siege Armies, General Ivanov, and Headquarters some difference of opinion on the question of the assault, the former advocating more vigorous action, the order issued by the latter was of a very guarded character, and *only the first task*—the capture of the advanced positions on the East Front—*was detailed.* Subsequent orders were to be issued as conditions changed in the course of the operations.

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On the 22nd March, at 7 p.m., General Headquarters sent the following order by telegraph to the staff of the siege armies :—

" The IInd Army, in the forenoon of 23rd March, will attack and occupy the advanced positions of the enemy on the East Sector with the troops of that sector. All the remaining Sectors will support this attack by a simultaneous attack."

On receipt of this order the Commander of the Siege Armies issued, on the same date, at 11.30 p.m., the following order to the siege armies :—

" On the army entrusted to my charge has been imposed the task of taking the advanced positions of the enemy and of throwing him back upon his fort line. I therefore order :—

(1). In the forenoon of 23rd March, at 1 p.m. (*sic*), the artillery preparation by all siege and field guns of all the Sectors will commence.

In the night, 23rd—24th, the infantry, with the support of the siege and field artillery, will attack and occupy by dawn the advanced positions of the enemy, in accordance with the instructions issued by me on 12th March." (These instructions are not in the possession of the writer).

At the time of the assault there were concentrated in the *East* Sector seven infantry brigades (14 regiments), with 22 q.f. field batteries (88 guns) and 98 siege guns. The following units of the Chatalja Army had been temporarily transferred :—One brigade, 4th Division (43rd and 44th Regiments) and one brigade, 3rd Division (29th and 31st Regiments). The composite cavalry brigade also operated on this front.

In the *South* Sector, which was that chosen for the subsidiary attack, and which was consequently the second in importance, there were concentrated two infantry brigades (of General Kirkov's Division), with 12 q.f. field batteries (48 guns) and 30 siege guns (28 Servian and 2 Bulgarian).

In the *West* Sector, there were three regiments of the Servian Danube Division, with their own field artillery and six heavy guns ; in the *North-West*, four regiments of Servian infantry (Timok and Danube Divisions) with field artillery and eight siege guns, and one Bulgarian regiment (55th). These fronts, having been chosen for the demonstration attacks only, were the third in importance.

In round numbers the Bulgarians numbered 105,000 men, and after deducting sick and ineffectives they remained 88,000 men with 240 field and 102 siege guns. For the Servians the numbers were :—Approximate total 47,000 men, effectives 32,000, with 60 field and 38 siege guns. The Servian siege park consisted of 10 long 10·5-c.m. guns (1897 pattern) ; eight 15-c.m. and twenty 12-c.m. q.f. Schneider howitzers (1907 pattern).

Events of 23rd March.—Exactly at 1 p.m., in accordance with the order, the artillery cannonade began in all the Sectors, except that in the East Sector it was decided that the fire *of the heavy guns* should not be opened, in order to mislead the enemy as to the direction of the main attack. The guns fired common shell for the purpose of demolishing cover, and at the same time showered shrapnel over the Turkish batteries and advanced positions.

The Servian howitzers shelled the Turkish concrete batteries and advanced infantry positions with great accuracy. The Turkish batteries replied energetically throughout the whole fortress area, but owing to the measures taken—the overhead cover—there were no losses in the batteries of the attack ; while the Turkish gunners suffered heavily.

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There was no general direction of the Turkish artillery fire, they had no good observation stations and no co-operation with the infantry. The batteries may be said to have fired at random, striving to find the well-concealed batteries of the Allies, and *paying no attention to their observation stations.*

The artillery fight continued up to 8 p.m. when the batteries of the attack on the East and South Sectors ceased fire, in order to allow their infantry to take up positions from which to start for the capture of the enemy's advanced positions, and at the same time to deceive the defenders. On the other sectors the artillery fire continued. This completed the events of this day.

In the night 23rd—24th the infantry attack began in all the sectors. On the approach of darkness General Kirkov's Division led the way by making an energetic attack on the South Front, with the endeavour to capture the Turkish advanced positions Pamuk-Sirti and Doudjaros. The attack was signalized by great resolution, but the heavy fire of the defence stopped the attacking troops, who forthwith actively entrenched themselves.

At the same time the Servians opened attacks on the North-West and West Sectors. Their artillery, after battering the Turkish advanced positions during the day, continued effective fire during the infantry attack, with the result that the infantry without great loss captured the Kadin-Keui and Yekmekchi-Keui positions on the North-West Front, but they failed against Uch-Tepeler.

On the West Front the attack was met with very heavy fire from the Turkish front trenches, and by daybreak after a hard fight the Servians had moved forward but 300 metres from their starting position.

These events took place in the sectors of secondary importance, but the attack on the important front made itself felt considerably later. This circumstance, in conjunction with the fire of the Servian heavy artillery and the bold attacks of General Kirkov's Division, deceived the fortress staff as to the principal front of attack. Feeling confident as to the safety of his East Front, where he had " strong forts " and ground generally " not easily accessible to assault," Shukri Pasha looked anxiously towards the South Front, where there were only " weak rifle trenches," not always protected by obstacles. Here he brought his reserves, as with only one bridge spanning the Maritza, it was impossible to transfer troops rapidly from one bank to the other.

Meanwhile the decisive events were maturing on the east, and at 3.30 a.m. on the 24th the infantry moved in perfect silence into the valley of the Kum-Dere Stream. The regiments advanced at battalion intervals, with three battalions in front line and the fourth as regimental reserve in rear, each battalion in two-company columns, covered in front by a thick skirmishing line. They directed their advance by the moon which was behind them, and they also had lamps, and were led by scouts who had recently well reconnoitred the ground.

On the North Section, opposite the line Tash-Tabiya—Aivas-Baba, parties of the 11th Division moved down the wide valleys of the Chirigan-Dere and Kurudji-Dere, which led them directly upon the points of attack assigned to them. (See *Plan* I.).

At 4.15 a.m. the troops on the East Section had crossed the Kum-

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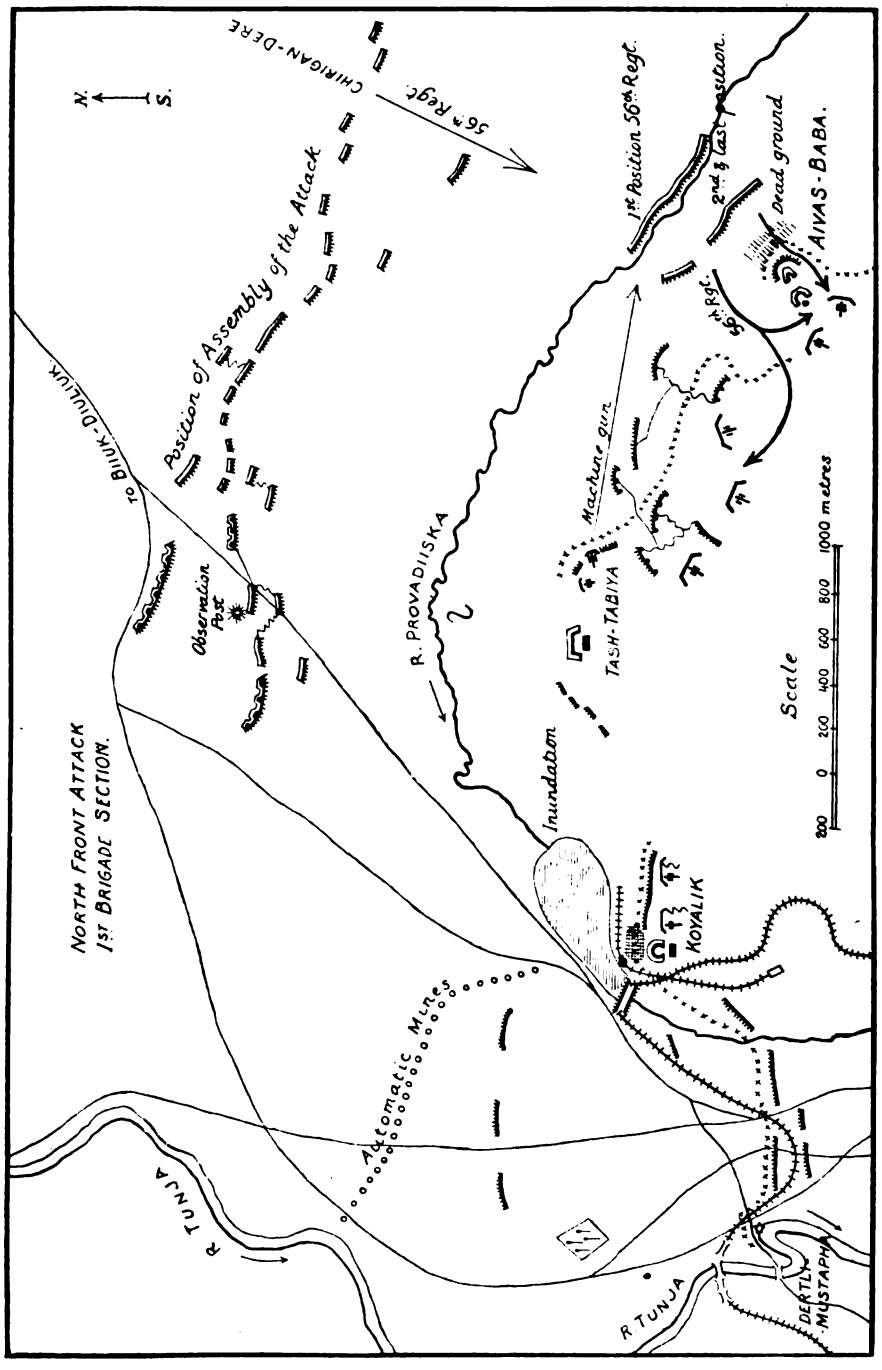

PLAN 1.

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Dere, while those on the North had reached the Provadiisca, and in the still-reigning darkness attacked the Turks. These latter met the attack, when within 800 metres, with heavy rifle, machine-gun, and artillery fire; but when *at* 5 *a.m.* there opened unexpectedly upon them the fire of a hundred heavy guns, raking their positions with enfilade fire, they turned and fled from the advanced positions towards their main fort line, pursued by the Bulgarians. But they soon encountered their own wire entanglement, and here many of them fell from the enemy's fire, while others surrendered themselves prisoners.

By 6 a.m. all the advanced positions of the East Front from Maslak to Demir-Kapu had fallen into the hands of the Bulgarians, who here captured 20 guns and several machine guns, which were immediately turned upon the retreating Turks. But circumstances were not so favourable for the northern groups. Dawn found them in the Provadiisca Valley, and with it the Turks opened upon them a very heavy fire from the direction of Tash-Tabiya, striking the 56th Regiment in flank with machine-gun fire. The fire of the heavy guns of the attack, belonging to the North-East (No. 2) Group, struck this section of the Turkish front in enfilade; their forts and batteries were quickly reduced to silence, but some *short lengths of trenches* on the slopes of Tash-Tabiya, *with machine guns concealed in them*, prevented the 56th Regiment from moving further forward.

By 7 a.m. the devastating effect of the siege artillery fire had exceeded even the expectations of the Bulgarians themselves. All the Turkish batteries of the East Front were silenced, and their gun crews had either been slain by the shrapnel, as there was no head cover, or had fled in panic. Their infantry also, deprived of cover, as the casemates of the forts had been demolished by the artillery fire, fled in large numbers, so that their rifle fire also almost ceased, and only small groups remained *in the interval trenches*.

This moment would have been a very favourable one for the further attack of the main Turkish position, but the Bulgarians did not avail themselves of it. Their attacking troops were in disorder and their reserves were still far distant, a heavy fog had arisen and it had become difficult to find their bearings, and furthermore they were unaware of the results of the artillery bombardment.

They nevertheless took advantage of the fog to work their way somewhat forward and to entrench.

By dawn, therefore, on the 24th, the task which had been set them, that of capturing the advanced positions of the East Front, had been accomplished.

At 10 a.m. the fog rose; the Turks had taken advantage of the respite allowed them and had regained order, and now opened a heavy fire on the front parties of the Bulgarians who were entrenching at the foot of the ridge, while the fortress batteries sited in the neighbourhood of Kuru-Cheshme and to the south of it, which had suffered least, opened fire on the advanced positions, now occupied by the Bulgarians, the ranges of which they had already ascertained accurately. The troops in the Maslak and Mal-Tepe positions suffered especially heavy losses.

As soon as he recognized what was happening, the Commander of the Siege Armies decided that the time had come for giving the final blow

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and for capturing the fortress, and with this object he issued the following short order :—" Attack the forts of the East Front and capture them."

The attack was fixed for 2 p.m., simultaneously with attacks in the other Sectors, but later the staff recognized that an attack by daylight, even though the defenders were badly shaken, would entail heavy losses, as some of the trenches and some well-concealed machine guns in the intervals between the forts were still firing. The attack was therefore postponed to 10 p.m. after the moon had risen.

The fire fight continued the whole day in all the Sectors. General Kirkov's Division, hearing of the success on the East Front, tried again and again with great resolution to capture the positions on the South Front, but without success. Still, entrenching themselves step by step, parties of the 30th, 51st and 12th Regiments drew nearer to the Turkish trenches.

The Servian 15-c.m. howitzers continued to shell the concrete batteries, and although the latter were well concealed the accuracy of the firing was very great. Only the flashes of the discharges from the batteries, and the guns of Battery No. 62, were visible. These batteries were soon silenced, but others of the Turkish batteries continued firing.

The artillery of the attack on the South Front failed to obtain the range of the well-concealed trenches on Pamuk-Sirti and Tokat-Bair, which were sited on ground of low relief, but on the East Front the Bulgarian guns continued to batter the forts and batteries sited on the sharply defined ridge. In these batteries it is said that as many as four reliefs of their gun crews were destroyed. By evening the batteries and forts of the East Front were silenced, *but the trenches in the intervals between them still remained active.*

The state of affairs by evening on the 24th March was as follows :— In the North Section of the East Front the 56th Regiment passed the whole day in the ravine of the Provadiisca, digging " Boer " holes in the river bank, in order to obtain cover from the machine guns which enfiladed them from the direction of Tash-Tabiya.

On the East Section the forward parties lay in trenches dug *at the foot of the ridge* within 150 to 200 metres from the fort line. The greater numbers were collected in the dead ground near Hasan-Aga in the Provadiisca Valley, and the reserves in rear of the crest of the ridge containing the advanced positions, which latter were now adapted to the service of the attack.

On the South Front the advanced positions had not fallen. In the section of the 30th Regiment one battalion had dug themselves in within 200 paces from the Turkish trench on Pamuk-Sirti. The 12th Regiment attempted by daylight to drive the Turks from their front trench at Doudjaros, but could not get through the wire entanglements. They were driven back with heavy losses and dug themselves in within 300 paces from the fatal trench.

On the West Front the Danube Division fought all day on Papas-Tepe, and by evening were entrenched 500 paces from the front trenches of the Turks.

On the North-West Front the troops still held the captured positions Kadin-Keui and Yekmekchi Keui, but had advanced no further forward.

Events of the Night of the 24th—25th, and of the 25th March.—On the

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approach of darkness the Bulgarian pioneers set to work to drive passages through the wire obstacles. As the artillery continued battering the Turkish positions with heavy enfilade fire, the pioneers suffered little loss, not more than about 60 men being hit on the whole North-East Front. The writer was able to obtain accurate information of the organization of this work in the first brigade section of the 11th Infantry Division (54th and 56th Regiments), which attacked the section from the Tunja to the Fort Aivas-Baba, inclusive.

In this section the pioneers belonged to the half-company under the command of Capt. Silvestrov. The men were divided up into parties of four or five, to each of which there were attached some infantry from the 54th and 56th Regiments. The parties were equipped with wire cutters.

It was decided to make *not one wide passage, but a number of narrow passages disposed at short intervals from one another*, along the whole front of attack, so that the attacking troops should not crowd the passages, but should cross the obstacle on a wide front. The small parties were sent forward at intervals of 20 paces, and the following table shows the results obtained, all the measurements being given in metres :—

No. of Passage.	Distance from Preceding One.	Width of Passage.	Remarks.	No. of Passage.	Distance from Preceding One.	Width of Passage.	Remarks.
1		6	30 metres from the beginning of Tash-Tabiya, working eastwards. Both metal and wooden stakes were met with.	24	25	2	
				25	6	2	
				26	8	3	
				27	12	3	
				28	40	6	
				29	280	8	Wire cut and poles bent down.
2	50	4					
3	30	2		30	200	6	
4	8	3		31	450	6	
5	30	8		32	60	2	Wire cut by artillery fire.
6	35	6					
7	15	4		33	25	2	
8	20	6		34	30	3	
9	10	4		35	10	6	At the beginning of Aivas-Baba.
10	15	4					
11	10	2		36	6	20	
12	20	4		37	20	3	
13	30	4		38	50	3	
14	20	4		39	80	30	
15	30	6		40	10	1	From five shells which fell one behind the other.
16	15	8					
17	50	2					
18	10	3		41	30	6	
19	5	4		42	60	6	
20	35	4		43	25	4	From two shells and wire cutters.
21	20	4					
22	15	25		44	20	3	
23	20	2					

The large distances between Nos 29, 30 and 31 were due, it appears, to the fact that here the Turkish trenches were in front of the wire entanglements.

Near Fort Aivas-Baba there was a passage (No. 36) 20 metres in width, which was made in the section of the wire entanglement which had here been erected *in dead ground* in front of the front face of the fort. In this place the pioneers were able to do their work completely at their leisure.

The parties were equipped with the light shields, but the latter were of no use. Corpses of sappers were found afterwards whose shields had been pierced by the sharp-nosed bullets

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Concentrated charges of pyroxiline had been got ready on light barrows with long handles, but these were not used.

At moonrise the general assault of the fortress began in all the Sectors.

On the North-East Front a heavy bombardment of the fort line by the artillery began at midnight, under cover of which the Bulgarian infantry moved forward.

The 10th Rodopski, the 23rd Shipka and the 56th Regiments were detailed for the attacks on Forts Aivas-Baba, Aidji-Yolu and Tash-Tabiya, and these were met with heavy fire from the trenches in the intervals. Owing to the terribly destructive effect of the artillery fire the infantry were able to traverse the obstacles without serious losses (only about one hundred corpses lay near them along the whole front of attack), as the Turks were obliged to evacuate the greater part of their positions and fall back in disorder.

After this the fire of the heavy artillery was directed upon the rear side of the ridge in order to prevent the approach of the Turkish reserves.

At about 2 a.m. Fort Aidji-Yolu, the first to fall, was captured by the 10th Regiment, who found it already abandoned by the Turks, so that here no hand-to-hand fighting took place. In the attack on Aivas-Baba the 23rd Regiment came under the fire of an unfinished work which was in the interval between it and Aidji-Yolu, and of a short trench containing a machine gun. The fire of these apparently negligible works stopped the frontal attack, in spite of the fact that the forts and batteries had long been evacuated by the Turks, who had been driven out by the fire of the artillery.

The artillery fire was once more concentrated upon this section, showing clearly the importance of a general direction of fire, and at the same time an attack in flank was begun from the direction of the captured fort. As a result of these measures the fort was finally taken at dawn, four hours after the fall of Aidji-Yolu.

This was the critical period of the fight for the Bulgarians, as the Turks, now knowing the true objectives of the attack, might yet have taken measures to paralyze their success. But Shukri-Pasha would not believe that it was possible to carry the forts of the East Front by assault, and he was still deceived by the desperate nature of the fighting on the South Front.

As a consequence of the fall of the first two forts, Tash-Tabiya was taken at dawn without serious difficulty. The Bulgarians at once brought up field artillery to the captured sections of the position, both guns and howitzers, and opened fire on the retreating Turks. All the forts of the East Front fell by 8 a.m., and the Turks in large masses fled in panic through the town, in the direction of the North-West Front, throwing away their rifles along the road.

The commandant, now recognizing the fall of the fortress as inevitable, gave orders to demolish everything possible, and at 8.30 a.m. the first explosion occurred, that of a concrete magazine in the neighbourhood of the Shaitan Tarla Group.

Some Turkish batteries of the North-West Sector, near the Yanlik-Kashli Barracks, opened fire on the eastern forts, where a crowd of Bulgarian troops were seen to be collected.

The composite cavalry brigade, under Colonel Markolev, containing

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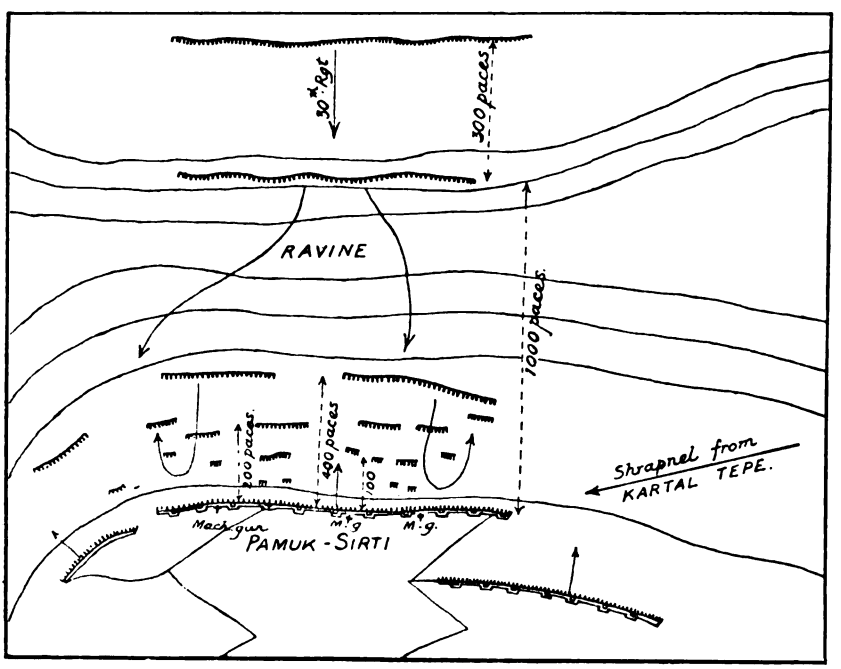
squadrons of the Bulgarian Guards and of Servian cavalry were, by order of the Commander of the Siege Armies, the first to break into the town. They galloped through it, though it was still full of Turkish soldiers, losing about 25 men, and were followed at 9.30 a.m. by the 23rd Shipka Regiment with their band. Part of the Bulgarian troops crossed the Tunja and halted near the Yanlik-Kashli Barracks for the purpose of disarming the Turkish prisoners.

Up to this time the fighting in the other sectors still continued. During the night, on the North-West Front, the Servians succeeded in capturing Uch-Tepeler, but in the other sections of this Front no further advance was made. The action of the Danube Division, on the West Front, was far more energetic. Having concentrated very heavy fire on the strong point on the summit of Papas-Tepe, the Servians moved along the low ground to envelop both flanks of the position, and thus compelled the Turks to evacuate the strong point. By dawn they had retired to the summit of Bekchi-Tepe.

On the South Front the attack on the advanced positions continued all night. The 30th Regiment (11th Company) reached the fatal trench on Pamuk-Sirti, but were thrown out again with great loss, and the greater part of the men lay down in trenches within 200 paces of the Turks. But a few dare-devils crept up to within 30 or 40 paces, and entrenching there kept up a spirited fire fight with the enemy.



Attack of 30th Regiment on the Pamuk-Sirti position.

At dawn, seeing the fall of the East Front, the 12th Regiment, in the Daudjaros Section, burst in a crowd from their trench, which was, as mentioned above, within 300 paces of the Turks, and with a loss of 480 men got up to the wire entanglement, which they began to demolish with their hands, pulling down the wooden stakes. Seeing this the

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garrison put up the white flag; but it was too late, for the Bulgarians with cries of "Hoorah!" broke into their trench and slew them all, not sparing even those who had run for shelter to the dug-outs.

At this time conferences began, treating of surrender in the sections of the 30th and 51st Regiments, which had not succeeded in capturing the Turkish positions opposed to them.

On the North-West Sector the Turks proposed surrender on certain conditions, but the Servians insisted on unconditional surrender, and to this the Turks consented. At 10 a.m. the troops occupied the line of forts without fighting, and at noon the second fort line. The South Sector had surrendered at 11 a.m.

By 1 p.m. the firing and explosions had ceased. By order of the Commander of the Siege Armies the troops halted on the positions which they had occupied.

At 2.30 p.m. Shukri-Pasha and his staff surrendered officially to the Commander of the Siege Armies, his place of residence having been discovered during the morning by the cavalry scouts.

Thus was the assault successful, and the fortress entered from the east, where the Bulgarians stormed the forts. *The other fronts were not captured* in spite of the great efforts of the Allies, but fell under the threat of attack in the rear.

The losses of the Allied troops were declared to have been as follows:—

	Killed.		Wounded.	
	Officers.	Men.	Officers.	Men.
In the East Sector	16	949	62	5209
In the South Sector	8	325	20	1364
Total losses of the Bulgarians ..	24	1274	82	6573
In the North-West Sector	4	69	2	360
In the West Sector	2	199	5	806
Total losses of the Servians ..	6	208	7	1166

The losses of the Bulgarians amounted to 8·5 per cent., and those of the Servians to 4·5 per cent., of the troops who were present in the action. These losses may be considered very moderate, a result due to the clever organization of the assault, and to the technical errors in the construction of the works of defence.

The Turks lost, during the whole siege, about 15,000 killed and wounded; the prisoners numbered 60,000 rank and file, 14 Pashas and 2,000 officers. The spoils included 14 stand of colours, more than 600 guns, 20 motor lorries, and great quantities of provisions and munitions of war.

Notes made on an Inspection of the Scene of the Fighting after the Assault.

The North-East Front was the chief sufferer from the artillery fire of the attack, and especially the Forts Tash-Tabiya, Aivas-Baba and Aidji-Yolu, in which the greater part of the brick casemates were demolished.

All the ground in rear of these forts was literally ploughed up with the explosions of high-explosive shells, but a sector magazine, which was very close to Aivas-Baba on the reverse slope, escaped injury.

There were very few hits in the neighbouring trenches in the intervals; the trenches were not damaged, but they contained many corpses of Turks who had been killed by shrapnel. There were quantities of empty cartridge cases in the trenches and on the glacis of the forts which were

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used as rifle positions. Most of the Turkish corpses lay in the ditches of the forts, where they had fallen from the covered ways, and in rear of the forts; the greater number of them had been killed by shrapnel.

In the batteries of the East Front only three or four guns had been damaged. A few of the light splinter- and shrapnel-proof shelters had been demolished, but the majority of them had escaped.

The wire entanglements had suffered very little from high-explosive shells. This is also evident from the table given above, in which only three passages are shown as having been made by artillery fire.

In the advanced positions on the East Front the damage done to the trenches by high-explosive shells was very small, although these trenches were sited on the "military crests" and very badly concealed, but the whole area was strewn with shrapnel bullets and splinters of shells. The quantity of blood-stained Turkish clothing bore witness that the losses from fire in these trenches had been very great. The trenches were of "full" profile (with a firing step), with traverses at 10-metre intervals, but, as elsewhere, without any form of overhead cover. Some of the Bulgarian shields of French design were lying about.

An inspection of the approaches to the forts of the North-East Front disclosed that on the north side (the attack of the 56th Regiment) the first pause had occurred on the bank of the Provadiisca Stream. The bank was adapted to form a rifle position, and recesses had been cut in it as a protection against the enfilade fire from the direction of Tash-Tabiya. The right flank section, which lay in the valley with its flank towards the machine guns, and apparently unsuccessfully entrenched, had been killed to a man, one by one. In the other parts the losses had been insignificant. At 200 metres from the stream (and 300 metres from Aivas-Baba), at the foot of the ridge, was the second and last position of the attack, in the form of separate rifle pits for firing lying. On the approaches to Fort Aivas-Baba from the east (the attacks of the 23rd and 10th Regiments), there were at the foot of the ridge some sections of trenches for firing lying, excavated in complete irregularity. No other works made by the attack were noticed in this section. In Fort Aidji-Yolu the efforts of the attack to adapt the fort, after its capture, to their own use were noticed.

On the South Front the trenches had suffered little from artillery fire, but the concrete battery No. 62, for six 15-c.m. guns, had suffered very badly. On one traverse there were three hits from the Servian 15-c.m. howitzer shells. All the area occupied by the battery was cut up by craters of shells, and on the guns there were many scratches and grazes from splinters and shrapnel bullets. In one case a roof of ferro-concrete, 17·7 in. in thickness, had been wrecked by a single shell.

The neighbouring concrete batteries, *the flashes of discharge of whose guns had not been seen*, had suffered little. There were no craters of high-explosive shells within 230 yards of them, but many traces of shrapnel fire.

The entrenchments on the South Front showed the resolution of the attack and the strength of the fire of the defence. In the section of the 30th Regiment, to which fell the heaviest fighting before Pamuk-Sirti, the first trenches of the attack lay at the distance of about a kilometre from the Turkish trench. The next position, trenches for riflemen standing made during the attack, was at 300 to 400 paces from the first. After this the attackers descended into a ravine, and entrenched them-

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selves on the ridge 400 paces from the Turkish trench. This trench, capable of holding a battalion, was of the profile "firing standing on the bottom of the trench." Beyond this, there were only short lengths of trench, for a section, a squad, or file, with profiles for firing lying. Still further, at 100 paces from the trench, there were more attack trenches of the same nature, with quantities of expended cartridges. Some Bulgarian corpses lay here. Individuals had crept even 30 to 40 paces nearer and had entrenched. The attack could approach no nearer. The "unapproachable" Turkish trench was like a fissure in the ground, completely merged in the landscape.

In the central section of the South Front, in the course of the two days' fighting and at a distance of 900 to 1,000 paces, the attackers had made seven lines of trenches, of various profiles.

On the left flank, at Doudjaros, the 12th Tunja Regiment had made two lines of trenches, the nearer of which was 300 paces from the Turkish trench, and in which, lightly covered with earth and brushwood, lay the bodies of the Turks slain in the hand-to-hand fighting.

On the West and North-West Sectors there were no demolitions caused by artillery fire, as here there were very few guns of large calibre, but all the Turkish advanced positions were so strewn with shrapnel bullets, that in every 12 square feet there lay from two to three bullets.

On these sectors there were no traces of the close attack. The Servians opposite Papas-Tepe had trenches for firing standing, not nearer than 600 to 700 metres to the Turkish front trenches, but in the Maritza Valley their trenches were nearer. On the North-West Front the advanced positions Kadik-Keui and Yekmekchi-Keui Farm had been adapted to defence by the attack. On the approaches to Uch-Tepeler craters of 21-c.m. high-explosive shells were to be seen, which had evidently been fired by the Turks against the attacking troops of the Allies.

Before the surrender the Turks had begun to destroy and demolish whatever they could. On the East Sector, which had been taken by assault, they had done nothing in this way. On the West Sector, where the Papas-Tepe Group was of field character, there was nothing to destroy except the guns, and they were uninjured. In the South Sector the gorge barracks in Fort Marash had been blown up, and the whole interior of the fort had the appearance of an enormous crater.

On the North-West Sector the concrete magazine in the area of the Shaitan-Tarla Group had been demolished, and some of the guns had been cut off near the muzzle by dynamite charges. The big searchlight in Shaitan Tarla had been burnt. In Fort Hedirlik the wireless telegraph station was damaged and burnt. In the centre of this fort was an enormous heap of burnt cartridges, rifles and other articles. Some rifles had been thrown into the wet ditch of the fort but were recovered by the Servians. Near this fort more than 300 artillery horses had been slaughtered. A motor lorry had been burnt, and also the Yanlik-Kashli Barracks, some provision stores, etc.

But the most serious damage was the demolition of the railway bridge over the Arda, which delayed for more than two weeks the passage of the Bulgarian trains to the south, during which time loads had to be transferred through Adrianople.

F. E. G. SKEY.

(To be concluded).

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HISTORY OF UNDERGROUND WARFARE.

Being a Review of the book by A. GENEZ, Captain of Engineers, French Army.—(Librarie Militaire Berger Levrault, Paris, Rue Des Beaux-Arts 5–7, 1914. Price 5 francs).

THE small importance of the sieges undertaken during the Franco-German War, with the exception of that of Belfort, has had the effect of diverting attention from the use of military mines as an aid in siege warfare. Other causes, such as the advent of heavy shells with large charges, the addition of pontoon bridging to the duties of the Engineers, and the introduction of short service also tended to the neglect of the art of mining. The Siege of Port Arthur, however, has shown that this art is not out of date, and the time seems opportune for reviewing the past in order to recall the glories of underground warfare, to follow its evolution, and to compare the successive characteristics of mining in attack and defence.

This history is divided into four principal periods :—

First period—up to the year 1487 when gunpowder was first employed in mines at the Siege of Serezzanella, near Florence.

Second period—that of breaching by means of mines, from 1487 to the Siege of Candia (1667 to 1669) during which the miner determined to meet his adversary under the glacis, and employ explosives against him.

Third period—from the Siege of Candia to that of Schweidnitz in 1762 where the *globe of compression* of Belidor was first made use of.

Fourth period—from the Siege of Schweidnitz to the present day.

FIRST PERIOD.

The use of mines in the attack is of great antiquity. The Siege of Fidenæ by the Romans in 430 B.C. furnishes a typical example. At this time the only object was to gain a footing unobserved within the defended locality. The employment of mines in defence was probably subsequent to their use in attack, and an old Greek author, writing on the subject of countermines, recommended that when it had been observed that the enemy was driving a mine, a deep ditch should be dug outside the ramparts, having its sides supported by masonry. This was to be filled with dry wood, and when the assailants broke into it, the wood was to be set on fire and covered over with earth to force the smoke into the enemy's gallery. Another suggestion was that the introduction of swarms of bees into the mine would cause no little inconvenience to the assailants.

Again, he mentions the Siege of Barca by Amaris, King of Egypt. The defenders were convinced that a mine was being driven under the fortifications, but could not discover on which side. A tinsmith conceived the idea of using a bronze shield as a stethoscope. Applying it methodically to the ground in various places, he soon discovered where

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the miners were at work. A countermine was then sunk above the besiegers' gallery, and the defenders, having the advantage of the command, soon drove out their assailants.

Polybius gives an account of a breaching mine at the Siege of Pale. Philip III. of Macedonia caused galleries to be excavated up to the walls, with branches under the foundations. The walls were then supported on wooden staging for a length of two arpents (480 ft.). When all was ready the staging was set on fire, with the result that the walls collapsed, forming a practicable breach through which the besiegers rushed and captured the town. It is probable that holes from the galleries were made at intervals outside the walls to allow the smoke to escape and improve the draught.

Philip successfully employed the same system at the Siege of Thebes, but at Apollonia the defenders outwitted him. From inside the walls they drove galleries towards the front, and hung bronze vases in them. The vibration of one of the vases denoted the blows of a pick in a neighbouring mine, the position of which was carefully estimated. Above the supposed position of the mine, a countermine was excavated, in which were collected cauldrons of boiling water and pitch, night soil, and hot sand. During the night shafts were sunk to the mine and the materials thrown into it, killing all the workmen.

During the Milhridatic Wars at the Siege of Thermiscyra countermines were dug over the assailants' mines, and bears, and other wild beasts, also hives of bees, were lowered into them.

Many other instances occur in ancient times, and in the Middle Ages, of the use of mines both in attack and defence. One of the most striking of these is the Siege of Chateau Gaillard by Philip Augustus in 1204. The defenders excavated their countermines too close to the foundations of their wall, with the consequence that it soon fell under the blows of stones hurled from a ballista.

At the Siege of Acre, which fell in 1291, Greek fire was used to set fire to the works. The wooden towers on wheels which the Crusaders had constructed, were set on fire by this substance. Philip Augustus, who was present at that siege, succeeded later in destroying by Greek fire the English fleet which was blockading Dieppe. About the same time Gaubert of Mantes set fire under water to a double stockade which protected the Island of Andelys, after having had fireworks, enclosed in pots of earth, fixed to it by divers.

Cæsar (De Bello Gallico. Vol. VII.) relates that the Gauls at Bourges destroyed his works by mining under them, a labour to which they were accustomed owing to the number of iron mines in the country! When the Romans excavated mines the Gauls broke into them, filled them with beams, sharpened, and hardened by fire, with pitch and heavy stones, and thus prevented the miners from approaching the walls.

SECOND PERIOD.

Gunpowder produced a great improvement in weapons of war, but was not used in mines until two and a-half centuries after its invention. The first attempt at modern mining was made in 1487 when the Genoese were attacking the Florentine town of Serazzano. One of their engineers

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filled his mine with powder instead of with staging and faggots, but as he did not tamp the charge the explosion took effect outwards, and the fortifications were not damaged. A Spanish soldier in the Genoese service, Peter of Navarre, who was at Serazzano and afterwards rejoined the Army of his own country, tried in 1500 to blow down the walls of the Castle of St. George on the Island of Cephalonia. The attempt was not altogether a success, but the breaches which were made led to the surrender of the castle.

About this period, during the quarrels of Louis XII. and Ferdinand II. over the partition of the Kingdom of Naples, the French in the forts surrounding the city of Naples were besieged by the Spaniards. Here Navarre determined to repeat his experiment and blow up the Chateau Neuf. On this occasion he was successful in effecting a practicable breach. The Chateau de L'Œuf was next attacked. Situated on a rocky peninsula almost cut off by the sea and defended on the land side by a deep ditch, the castle could only be approached by sea. Navarre roofed over some boats, and from them opened a gallery which he drove straight under the castle. In this he fired a mine by slow match, the rock was split, and a large portion of the wall of the castle fell. Many of the defenders were killed, the remainder were easily overpowered.

Navarre continued his brilliant career at the Siege of Bologna in 1512, and prepared a mine under the walls. The wall was blown vertically into the air for several feet, but fell again on to its foundations, hardly cracked. So high was it raised that the assailants actually saw beneath it the defending troops drawn up ready to repel their assault. From this failure Navarre learnt not to place his charge exactly under the centre of gravity of the mass to be shattered. That such an event is possible was exemplified in 1795 when the same phenomenon was repeated in blowing up a solidly constructed curtain during the demolition of Fontarabia.

Navarre had by this time achieved such a reputation that the Castle of Milan, which had already withstood several sieges and was considered impregnable, was surrendered with a strong garrison well supplied with food and munitions of war, by Duke Maximilian Sforza, as soon as it was known that Navarre was to conduct the siege.

Countermines were successfully employed at Marseilles in 1524, and at Naples in 1528, and the sieges were abandoned. In 1529 the Turks employed mines against Vienna. These were interrupted for the greater part by the countermines of the besieged, only a few could be fired and the assault was repulsed. The expedient of countermining therefore seems to have followed very quickly on Navarre's invention of powder mines.

Probably the earliest instance of countermines prepared deliberately in advance occurred at Padua, which was besieged in 1509 by the Emperor Maximilian I. with a mixed army of Germans, Italians, Spaniards and French. This town then belonged to the Republic of Venice, and was exceedingly well organized to resist a siege. The garrison was large, provisions plentiful, and there were two lines of defence, in the interval between which countermines had been prepared. A few exterior works of small importance had been captured when a strong effort was

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made against one of the bastions. A breach was made by the artillery sufficiently wide for the advance of 1,000 men. Two assaults failed, the third was successful, but scarcely had the last Venetian left the bastion when the mines beneath it were fired. Many distinguished generals were killed, and the Imperial troops were so dismayed that they were rapidly driven from all the works they had already captured.

The moral effect of this event was so great that Maximilian found it impossible to induce any of his troops to hazard a further assault, although he proposed that it should be led by the cream of his troops, the gendarmery of France. Never was such a demand for priests to hear the confessions of those who might be detailed for the assault. The Chevalier Bayard expressed great indignation that noblemen should be expected to risk their lives fighting with bakers, shoemakers, and such riff-raff, and advised that, as there were plenty of German counts, seigneurs, and gentlemen, they should be directed to support the gendarmery, who would willingly show them the way. It is well known how the Chevalier, " sans peur et sans reproche," shuddered at the idea of a bullet, the only weapons worthy of him were spear and sword wielded by gentlemen.

In 1601 an army composed of Spaniards, Germans, Italians and Belgians, under Marquis Spinola, laid siege to Ostend, which was held by a mixed garrison of Dutch, English and French. This city had been fortified by William of Orange, who protected it by a girdle of bastions. The attack was directed almost entirely against the front facing Nieuport ; on the attackers' left, near the sea, was the Sandhill Bastion, separated by a canal from the Hellemond Bastion, then the West Gate, South-West and Polder Bastions, and on the extreme right the South Bastion. Communication with the sea could not be interrupted, so that the defenders could by this means obtain supplies of all kinds. The Commandant was Colonel Vandernoot, an experienced and clever man.

Every attempt at a general assault failed, and in 1604 recourse was made to a step-by-step advance. To the Germans was entrusted the attack on the Sandhill, to the Spaniards that on the Hellemond, to the Belgians the West Bastion, and to the Italians the Polder and South Bastions.

A lunette called the Green Ravelin covering the Hellemond was first attacked in March, 1604. The earthwork of the salient was demolished by small mines, then called petards, and the salient captured. The work was cut in half by a palisade, to capture which mines had again to be employed. The besieged countermined, and combats took place in the galleries, but the besiegers managed to explode their mines, and the place was captured.

Meanwhile the Belgians mined the glacis of the West Bastion, and the explosion of " 9 tons of powder " (about 900 lbs.) enabled them to obtain possession of a ravelin which protected the front of the bastion, and to capture its garrison on 18th April. The descent of the ditch was then undertaken, and by 27th May it was possible to reach the escarp. The ditch was fordable, and a hard bottom was made with fascines and hurdles. To save time it was decided not to mine under the ditch, and though a deserter said that the parapet was countermined, six officers

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and soldiers volunteered to cross the ditch, and make an opening in the escarp. They advanced under a fierce fire from both flanks, but in half an hour the survivors had dug themselves in. A covered way was then made across the ditch, and in eight days' time 40 ft. of mine gallery had been excavated under the parapet. The mine chamber was loaded with 30 tons (3,000 lbs.) of powder.

Troops were drawn up for the assault, and a few men sent on to the parapet to draw the garrison out over the mine. The result of the discharge was to open a wide breach, but a great deal of the effect acted outwards, and killed or wounded numbers of the assailants. It also opened out the approach to the defenders' fire, and the assaulting troops lost heavily. A counter-attack by 400 men repulsed them to 60 paces from the ditch, their works in the crater were destroyed and their fascines burnt. A parapet 12 ft. high was then constructed to close the breach.

Several days were required by the assailants to regain the escarp, when the besieged themselves fired a mine, thereby disclosing a masked battery constructed behind the parapet, and which commanded the besiegers' approach. However a fresh mine was dug, and was about to be charged when the movements of the defenders seemed to indicate the preparation of a countermine. To make sure if this was the case or not the besiegers sent out a reconnaissance. The defenders thought this the prelude to an explosion, and themselves retired. The besiegers then waited for the discharge of the supposed countermine, and did not dare to return to their works until a spy had ascertained that no countermine existed. Eventually the mine was charged and fired at the end of June. Again the greater effect was produced outwards, and the assailants lost heavily. However the assault was delivered and half the bastion was taken, but another mine was necessary to capture the remainder.

On the besiegers' extreme right the Italians effected the passage of the ditch of the S.W. Bastion, and after several small explosions, each followed by a slight advance, managed to charge and fire a larger mine. The defenders countermined unsuccessfully, and the Italian mine formed a good crater from which they were able to make a further advance. At length the explosion of 2,000 lbs. of powder cleared the way for the final successful assault. But before this occurred the combatants often met below ground, where sanguinary encounters took place in the dark. Occasionally barrels of powder were accidentally fired, burying dead and living, or blowing up indiscriminately any combatants who might happen to be overhead.

The Spaniards advanced steadily towards the Hellemond, one of their mines uncovering a countermine which was just ready for firing. Another countermine was broken into, but a moment later a second close by was fired, and suffocated more than twenty of their workmen. An hour later the attack fired a mine which killed a number of the defenders, who had been enticed over it by the false alarm of an immediate assault. The capture of the Hellemond, which commanded and flanked the Sandhill, rendered possible the capture of the latter which it was almost impossible to mine as the sand fell in as quickly as it could be removed. It was taken on 13th September.

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The besiegers now found themselves confronted by a second enciente. The defenders compared Ostend to ancient Troy, and called their first line New Troy, the second Little Troy. However batteries erected on the outer line soon reduced to silence the guns of the inner lines, which were on a low parapet, commanded by the former. The defenders were not yet discouraged, they fired mines in the space between the two lines and compelled the besiegers to advance with circumspection. When the second line had been captured yet a third appeared. The Germans from the Sandhill were able to penetrate a work defending the old town, which they carried after exploding a mine, and on their right the Spaniards captured a large demilune. The defenders had now lost the key of their position, their communications with the sea were threatened. They capitulated on 20th September, 1604, after three years of siege, and seven months of underground warfare.

Subterranean works thus had an important bearing on the results of this siege, but it is noteworthy that the defenders only used countermines to enable them to reach the attackers' galleries, to fight them there, and do what damage they could by hand. They do not appear to have made any systematic use of gunpowder to destroy at a distance the galleries and mines of their opponents. The explosions of the defence had as object to check the assaulting columns, and to spread panic in their ranks. The way in which they utilized mines to suddenly clear the foreground and unmask batteries trained on the attackers' approaches is also worthy of notice.

In 1654 Arras was besieged by the Spaniards, and affords a good example of the employment of a grand parallel covering the artillery. Approaches from it by zigzag or double sap brought the besiegers to the counterscarp. Fresh batteries were erected on the glacis, and mines carried from them towards the most advanced work, which was not revetted, but had steep slopes with palisades in front. The defence was stubborn, and the attack could only advance step by step. On 1st August two shafts were sunk, whence galleries were driven towards the salient. Efforts to reach these by countermining were unsuccessful, and on the night 7th August the mines were fired with good effect, and the craters occupied after a three hours' fight. No further advance could be made, and mining had again to be resorted to. This time the defenders were successful in countermining, and hindered the work considerably, only giving way on 18th August. On 24th the palisades of the covered way of the place itself were blown up, but attacks made on that and the following day failed, and Turenne's Army arrived in time to raise the siege. In this case the defenders advanced underground to meet the attackers as the ancients had done, and were undeterred by fear of explosions.

Military mines had now reached such importance that much controversy took place in regard to their construction and destruction. The ancients attacked the bases of the walls, but the advent of artillery led to the use of thick parapets of earth, which was obtained from a ditch, and galleries had to be inclined, or shafts sunk, to obtain the necessary depth. Wider and deeper ditches made the labour of driving galleries excessive. The failure of the first powder mines demonstrated

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the necessity of tamping the charge, and this led to placing the charge in returns, and not at the actual end of the gallery. Long vertical or stepped shafts with horizontal galleries from them were easier to construct than inclined galleries, but communication was more difficult.

Chevalier Antoine de Ville, an engineer born in Toulouse, now suggested sinking shafts in steps each the height of a man, from which it was more easy to remove the earth than from deep shafts. These shafts were sunk chequer-wise to facilitate tamping. Occasionally shafts were sunk in the ditch itself, or the ditch was crossed by blinded galleries. De Ville also indicated a method of defence by countermines; a shaft was sunk in the terreplein of the fortress whence a gallery was driven to beyond the counterscarp. At its extremity a transverse gallery was made embracing all ground likely to be threatened by the enemy's mines. From the transverse gallery shallow shafts were sunk, and branch galleries from these, which were in turn joined up by a second transverse gallery. De Ville unequivocally condemned the counterscarp galleries of the first French and Italian bastion systems, and to him therefore belongs the honour of having invented the system of modern countermining.

Candia, held by the Venetians, was besieged by the Turks from May, 1667, to September, 1669. The Turks could not isolate it from the sea, so that supplies were constantly pouring in. On the land side it was defended by a good seven-faced bastioned front, covered by exterior works which were countermined with a view to their destruction when they could no longer be held. Captain-General Morosini was in command, and this siege has made his name famous. The Turks opened parallels, and tried to make use of mines, but the defenders listening in their galleries always detected them, blew them up, or penetrating the galleries, damaged or carried off the powder. One of the outer works was captured by the Turks at the end of the fifth month of the siege, and after being recaptured, was finally abandoned and blown up with its Turkish occupants by a charge of 7,000 lbs. of powder. During the first six months 618 mines were fired, and the Turks acknowledged losing 12,000 men by that agency. A mine containing 18,000 lbs. powder is recorded, and during the year 1668 the defenders expended 3,000,000 lbs. of powder.

De Morosini had more faith in mines than in sorties, and the disastrous result of one sortie confirmed him in this opinion. In 1669 he determined to blow up the salient, which the Turks had captured, of one of his bastions. The explosion was of terrible effect, but the Turks returned to the attack, and on their part, succeeded in destroying the remainder of the bastion by a mine. This opened the place, and the end of its defence was at hand when a French division arrived as reinforcement. Morosini was unable to deter them from making a sortie, and they succeeded in driving the Turks from their trenches. Unfortunately at this moment a few barrels of powder left in a battery exploded. The French, who for the last two years had heard of nothing but the fatalities caused at Candia by mines, mistook this explosion for the bursting of a mine. Consternation seized commander and soldiers; the ranks broke and fled. The Turks pursued, but were checked by the fire of the garrison.

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It was, however, impossible to restore confidence, the remainder of the French troops departed by sea, the Germans followed, and Morosini, left to his own resources, was obliged to capitulate.

This deplorable event again draws attention to the moral effect of mines. Napier records that at the assault of Badajoz half a British regiment, which had escaladed the wall, fled in disorder at the sight of a lighted match on the ground, which had just been used to fire a gun. Prior to the assault of the Malakoff at Sebastopol, the Engineers fired several large mines on the glacis, which would certainly have destroyed any of the enemy's mines which had happened to be near, but were, in fact, only fired to inspire confidence in the attacking troops by showing them that their own troops were masters of the ground. Chevalier de Ville pointed out a means of locating the enemy's mines by the use of a boring tool. At Candia borers were used, and the miners placed small charges at the bottoms of the holes and fired them when they heard the enemy at work near by. This siege was therefore the first at which bored mines were used.

The French engineer Castellan, who was at Candia, returned to France after the siege, and was employed by Vauban to direct the mining operations at the Siege of Maestricht. He doubtless told Vauban how the Turks, against whom every inch of ground had been disputed, had multiplied their trenches and places of arms. Vauban had already published his *Première Instruction sur les Sièges*. At that time it was usual to open only one parallel, and in it, under the name of the Royal Battery, to place all the guns destined for the bombardment of the fortress. At Maestricht Vauban applied a new method of attack which he had deduced from the Siege of Candia, and opened several parallels.

A.R.R.

(*To be continued*).

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THE UNIVERSAL IMPROVISED TRESTLE.

From an article in the February number of the *Mitteilungen über Gegenstände des Artillerie-und Geniewesens.*

THE importance of improvised bridges in war is incontestable. It varies according to the difficulty of getting the normal bridging equipment to the site—or even the impossibility of doing so—when, for example, the equipment would have to be replaced by improvised material in order that it might be available for use elsewhere.

Several kinds of trestles, transoms, etc., are used as a " permanent foundation " for improvised bridges. None of these, however, owing to their particular characteristics (quite apart from the question of strength) can be used on every occasion ; a very careful selection must be made according to the nature of the obstacle to be bridged. One type, for example, can be quickly and easily constructed but cannot be used in a strong current, while another type demands skilled labour, and therefore much time, in building.

Experience shows that, when time is short and there are no floating piers, rivers with rocky, stony or holding, muddy bottoms form very serious obstacles to any who are restricted to the " permanent foundations " which have been used hitherto.

The particular qualities that should be combined in a " permanent foundation " for improvised bridges, if such is to be suitable for use on service and fit for every emergency, are the following :—

1. The possibility of rapid construction under any circumstances ;
2. Simplicity in construction, to avoid the use of skilled labour ;
3. The maintenance of the same principle of construction, both for the lightest and the heaviest types of bridges ;
4. The greatest possible economy in material by means of a technically sound design ;
5. Adaptability to the most difficult conditions—unfavourable bottom, strong current, great depth of water, lack of floating material, etc.
6. The essential qualities of a hoist ; and
7. The possibility of use as a foundation for trestle bridges in tiers.

None of the " permanent foundations " hitherto in general use can claim all these qualities.

The universal trestle (Austrian patent No. 52050—1911) of Major Raimund Hamböck, commanding the 15th Pioneer Battalion, merits all the more attention, as it fulfils completely the conditions already mentioned and seems peculiarly fitted, by reason of its simplicity and easy method of construction combined with exceptional stability and adaptability, to be the model for improvised bridges.

The trestle (*Plate* I., *Fig.* 1) consists of :—

(*a*). Double legs, which combine the bearing legs, BL, and the auxiliary legs, AL.

(*b*). Shoes, S, which prevent the bearing legs from sinking into the ground (not required on rock).

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(*c*). Diagonal bracing, D, for the legs.

(*d*). Bearing spars, BS, which transfer the weight to the bearing legs.

(*e*). Transom, T.

(*f*). Transverse baulk, TB, which transfers the weight through the road-bearers, RB, to the transoms.

(*g*). Hoisting spars, HS, and wedges, W, for fixing the baulk, TB; the hoisting spars are also for raising and lowering the roadway.

The way to build the trestle is as follows :--

Before any bridging is attempted the section of the obstacle is rapidly taken. There is no need to take an accurate section, since the bearing legs—as explained later—are not cut to their exact length till they have been placed in position.

There is no trimmed timber in the trestle ; the spars are cut to length in the same state as that in which they are found or felled, in the latter case with the bark on.

The various members of the trestle are assembled at the spot where the timber is obtained. Each pair of double legs is joined together and, by means of lashings, trenails, dogs or bolts, the movable diagonals are fastened near the bottom of the legs ; shoes are lashed on too, should the nature of the bottom render them necessary.

All the other single members which have been detailed above are also prepared.

The trestle is constructed in separate parts. This is a particularly valuable feature, especially with heavy types of bridge, and is of even greater importance when surprise bridges are to be built, if wagons can be requisitioned to take the material to the site so that the detachment can build "direct from the wagon," as is done with normal bridging equipment.

A further great advantage of this method of construction is the fact that the bearing legs are not cut to their final length until they have been put in position.

The trestle accommodates itself, therefore, to the various inequalities of the ground caused by stones, rocks or holes, and the delays which are inevitable (should serious inequalities that the section has missed be encountered) in placing trestles which have been made up into one whole on the bank, are thereby avoided.

The construction in the water is carried out from a construction vessel (barge, boat or raft), which is provided, when conditions are difficult, with a construction scaffold, G, (*Plate* I., *Figs.* 2 and 3) ; from this scaffold the various members of the trestle are placed in position by means of guys.

The order of construction of the trestle is as follows :—

1. Shipping the various parts of the trestle on to the construction vessel.

2. Booming out and fixing the construction vessel, by means of baulks of a measured length, from the last trestle that has been built in bridge.

3. Simultaneous placing in position, that is to say, lowering the legs together with the diagonals (upright) up stream from the guide baulks, GB, which project from the shore side of the boat.

4. Simultaneous crossing of the diagonals and lashing them on opposite sides of the legs (*Plate* I., *Fig.* 3).

5. Cutting the bearing legs to the right length.

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HAMBÖCK'S UNIVERSAL TRESTLE.

Fig 1. Heavy Type.

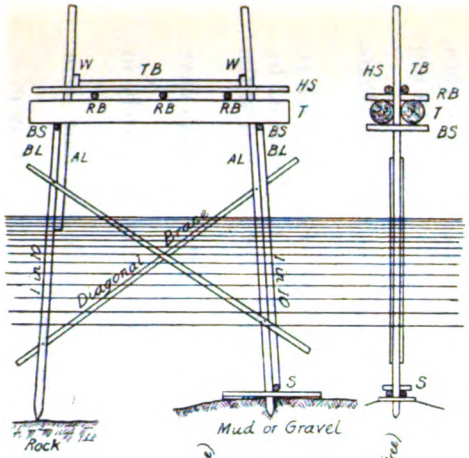
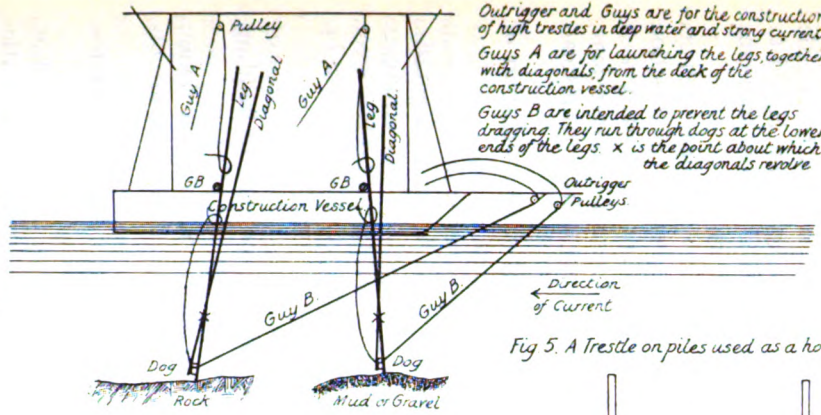


Fig 2. Construction Scaffold, G.



Outrigger and Guys are for the construction of high trestles in deep water and strong current.

Guys A are for launching the legs together with diagonals from the deck of the construction vessel.

Guys B are intended to prevent the legs dragging. They run through dogs at the lower ends of the legs. × is the point about which the diagonals revolve

Fig 5. A Trestle on piles used as a hoist

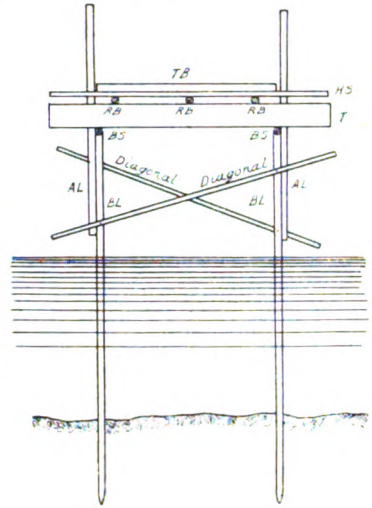
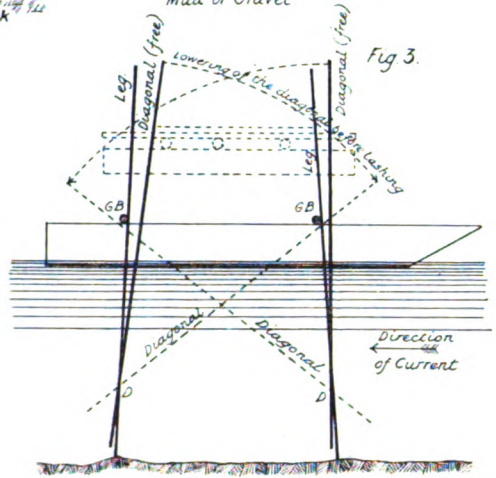
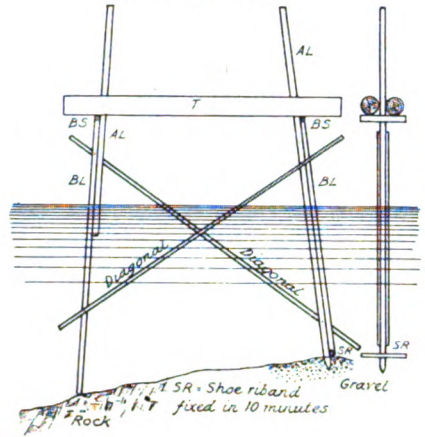


Fig. 3.



D = Movable diagonal, connected to the legs by lashings or bolts.

Fig 4. Light Type.



SR = Shoe riband fixed in 10 minutes

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6. Fixing the bearing spars, BS, the transoms, T ; the road-bearers, RB ; the baulk, TB ; the hoisting spars, HS, and the wedges, W.

7. Placing in position and lashing the roadway, and

8. Casting off the construction vessel.

When there is no water, the trestles are made up into a whole first, in the normal way. But with particularly heavy timbers the trestle can be built in separate parts ; the diagonal bracing is first lashed to the legs ; these are then erected, and the comparatively heavy transoms and the rest of the structure are put in position afterwards.

Plate I., *Fig.* 4, shows a universal trestle of a light type, such as would be built for footbridges, etc. The principles of construction inherent in the universal trestle for heavy bridges are very clearly seen in this type. The difference consists, apart from the smaller dimensions, in the absence of the transverse baulk and in the use of lashings instead of dogs and bolts.

It is obvious, too, that a transverse baulk, if it were a question of inserting a movable transom, could easily be added.

The construction is carried out exactly in the way which has been already described, with the simplifications which the lighter type entails.

By means of auxiliary trestles in tiers, the highest and strongest and therefore the heaviest foundations can be made for bridges over valleys and gorges. The principle of the universal trestle can also be applied with great advantage to piles (see *Plate* I., *Fig.* 5).

As this description is only intended to make known the principle of the universal trestle, a detailed description of the procedure of building a high arched bridge with several storeys would be out of place.

To close, a few data may be given, the results of actual work done ; they prove how eminently suitable is the Hamböck trestle for use on active service :—

(*a*). During training, Sappers built a heavy trestle bridge of improvised material to take the heaviest military vehicles.

Among others was a universal trestle, 17 ft. high, to take a load of 18 tons, in 14 ft. 6 in. of water with a current of 5 knots. The trestle was built within 15 minutes by a trained detachment. This is a convincing proof that, wherever a pile can be driven, this type of trestle can be set up.

(*b*). Trained infantry pioneers finished 58 yards of light bridge (*Plate* I., *Fig.* 4) in an hour.

(*c*). A light improvised bridge with lashed trestles (*Plate* I., *Fig.* 4), which was built over a creek, was, during 30 days' training, crossed by 100,000 fully equipped soldiers on the march, and by 100,000 men at the double, without any effect on its stability.

(*d*). In order to test the stability of a tier bridge 65 ft. high, guys were attached to both the outer, upper ends.

A party of 10 men was detailed to pull on each guy alternately in order to disturb the equilibrium of the structure.

The deviation, which could only be detected while the men were actually pulling, amounted to 3·9 in. on each side.

E.W.C.

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REVIEW.

THE EVERY-DAY USES OF PORTLAND CEMENT.

THIRD EDITION, 1913.

THE above work is published by the Associated Portland Cement Manufacturers, Ltd., Portland House, Lloyds Avenue, E.C. It is divided into Parts which deal with the subject under many headings, such as Portland Cement; Sand and Coarse Material; Concrete; Workmanship; Concrete-blocks and Moulded Concrete; Reinforced Concrete; Foundations; Walls, Piers and Posts; Interior Steps and Stairs; Paths and Pavements; Concrete for Roads; Joints in Drains; Manholes and Cesspools; Pipes, Mains, Conduits and Sewers; Houses; Various Buildings; Stables; Sheds; Silos; Bridges and Piers; Dams; Docks; Harbours and Canals; Rifle Ranges; Floating Docks and Pontoons; etc., etc., etc. The above will give an idea how comprehensive the work is and the facts are set forth in a clear and simple manner, the adaptability of concrete naturally finding great merit in the pages of a trade publication. There are numerous illustrations of work actually carried out and at the end of the book there is a useful set of "Memoranda for Concrete Users," which gives various valuable statistics and a handy Glossary. The work is certainly one which those engaged in the use of Portland Cement should read. Its popularity is proved by the fact that it has reached three editions in four years.

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NOTICE OF MAGAZINE.

REVUE MILITAIRE SUISSE.

June, 1914.

THE BATTLE OF SEMPACH.

Conclusion of article. Only historical.

FOLDING DISCS FOR VISUAL SIGNALLING.

The disc is made of aluminium in two halves, united by two hinges. When required for use it is opened and clipped on to the bayonet, which forms a handle for it; when not in use it is folded and strapped to the pack. It is claimed to be more easily seen than a flag of the same area, to be instantaneously fixed, and to be very strong and light. It can be used at night to veil or disclose a light.

REMARKS ON THE GREEK ARMY DURING THE CAMPAIGN IN EPIRUS.

These observations only apply to the mental and physical qualities of the soldier. The writer was not allowed in the front line, so can offer no remarks on the military operations or on the tactics employed. Commencing with an appreciation of the influence of modern Greek history on the national character, the progress of the army from its foundation in 1831 by King Otho I. to the present day is shortly sketched. The characteristics, dress, and equipment of each arm are then described in greater detail.

THE TRICOUMI NAIL.

This nail, intended for mountaineering, is described and illustrated. It is stated to be lighter than those in vogue hitherto, can be fixed closer to the edge of the sole of the boot, which gives a good grip on any small projection in the rock. It wears splendidly, does not tear the leather and get loose, and does not bruise the feet.

A.R.R.

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CORRESPONDENCE.

EAVES GUTTERS.

DEAR SIR,

With reference to Major G. Walker's letter of 4th May on the subject of eaves gutters.

In Mauritius in 1908, the following method of preventing water from lodging in dips in gutters was adopted :—

Holes were punched, or bored (according as the gutters were wrought or cast), at about 3-ft. intervals, of a size such that a galvanized iron nail used for fixing the shingles on the roofs would drop in.

The nails were dropped in, and during actual rain very little water came through the holes. After the rain had ceased the water ran down the nails and dripped off wherever there was a collection of water that was held up.

I do not know whether time has brought out any disadvantages, but while I was there the scheme worked very well and saved the cost of the labour of cleaning out the water which, as there were a number of unoccupied buildings in my Division, was considerable.

Yours faithfully,

A. R. A. IREMONGER,
Lieut., R.E.

Glen Hewen, Devonshire, Bermuda,
24th June, 1914.

The Editor, *R.E. Journal.*

SOME WAR MEDALS OF THE BENGAL SAPPERS & MINERS.

SIR,

The medals depicted in the illustrations accompanying Lieut. Hobart's article in the August number of the *Journal* are of great interest, and the 1st Sappers & Miners are to be congratulated on their acquisition.

There are, however, one or two points on which I hope that Lieut. Hobart can give additional information.

(1). From an inspection of the photographs forwarded it would appear that neither the Nepaul nor Burmese War Medals of Subadar-Major Ganga Singh, are *original* issues of 1816 and 1826 respectively. The suspender of the Burmese War Medal is of a type not introduced until 1846, the original mounting being an iron clip and ring like the Waterloo

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Medal. From a technical point of view great value attaches to a medal being an original issue, and not a re-issue or a late issue.

(2). It would be of very great interest to know the details of Ganga Singh's services in the Nepaul War. The War lasted from October, 1814, until the middle of March, 1816, and the medal was authorized by the Governor-General by G.G.O. dated 20th March, 1816. It was restricted "to every Native officer who actually served within the hills, and to as many of the Non-Commissioned Officers and Privates as shall be recommended by the Commanders of their respective Battalions for distinguished zeal or gallantry in the course of that duty."

The medal was not given for operations unconnected with Nepaul, *e.g.* the Capture of Hathras in 1817; but the Native survivors of the Nepaul War, who had not received the Company's medal, received the Army of India Medal with clasp "Nepaul" in 1851.

(3). The Jellalabad Medal of Ganga Singh's is the "Flying Victory" or second medal. The date on which he exchanged his first medal for this one would be of great interest and value to the "scientific" collector.

(4). Information as to the column with which Basawan Singh served in the 2nd Afghan War would be interesting as completing the details of this veteran's services.

I trust that Lieut. Hobart will be able to supplement his valuable contribution by giving information on these points, and I hope that his example will be followed by other Messes, which own relics of a similarly interesting nature.

Yours faithfully,

H. BIDDULPH,

Major, R.E.

The Editor, *R.E. Journal*.

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OBSTACLES.

THEIR TACTICAL USE, CONSTRUCTION, AND METHODS OF DESTRUCTION OR SURMOUNTING THEM.

A Lecture given by Bt. Lt.-Col. R. N. Harvey, d.s.o., R.E., *to No. 5 Senior Officers' Class.*

There are many reasons why the subject of obstacles has never received from the Army generally that degree of detailed study to which it is entitled; but the chief one is, I think, that few of us have ever had any practical experience either in the true effect which an obstacle, sited and constructed on sound tactical principles, has on the troops of the attack, or of the degree of security which such an obstacle may confer on the defenders.

Before going further, I want to lay down the following axiom :—

Obstacles are divided into two classes,

(1). Obstacles for hasty defences, when the time available for work is limited to a few hours.

(2). Obstacles for deliberate or permanent defences.

This may appear to some a fairly obvious statement, but I have found, when discussing this subject with other officers, that the experience gained in recent wars on the use of obstacles, is applied indiscriminately, without any regard to the circumstances under which the obstacles were made or the nature of the operations during which they were used.

For instance, the suggestion that a hedge might be made into an efficient though surmountable obstacle in a hasty field defence scheme has been swept aside by a reference to the effect of an 11-in. howitzer shell or to the possibility of the destruction of the obstacle by a torpedo, both of which are methods connected with siege operations, or at all events with operations of a deliberate nature.

Any scheme for the construction of obstacles must be considered under the following heads :—

1. They must be properly sited.

2. The purposes for which they are required must be clearly understood by those who make them.

3. The proposals must have reference to the material, time and labour available.

4. The enemy should be credited with all reasonable means for destruction, or for crossing them.

The principles which govern the first of these are the same for

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both hasty and deliberate operations, but those which govern the other three obviously vary in very great degree according to circumstances.

For the first head "Siting." The principles to be observed are :—

1. The obstacles must be under the close rifle fire of the defence.

2. They should give as little cover as possible to the attack.

3. If the defences are concealed, the obstacles must be concealed from view too, otherwise they betray the approximate position of the defences.

The term "Close fire" is one that requires definition. It is, I think, the maximum range at which the obstacle can be effectively commanded on an average dark night, say 100 yards; this distance may be reduced, but, if it is under 50 yards, an attack by grenades thrown by hand must be anticipated.

The defence of the obstacle against creepers on very dark nights requires special precautions, such as sentries, alarms, etc., but it is suggested that the maximum security will be given by constructing rifle pits close up to, or within the obstacles. These pits will be held by specially picked men sent out after dusk, and withdrawn just before dawn.

I want to lay particular stress on the importance of siting the obstacles. I think it is almost as important as the siting of the fire trench. Nearly all of us have suffered, at one time or another, from having to occupy trenches sited by officers who remained mounted, or even standing, when they made their decisions; all ranks are now impressed with the importance of siting fire trenches by assuming the same level of the eye as that of the man who will occupy the trench. So also in siting obstacles, it is of supreme importance to do so from the level of the eye of the man whose fire is to command them. Let us now consider how the remaining three heads apply to obstacles of Class 1, *i.e.* in a scheme for hasty defence.

The second head is the purposes for which the obstacles are constructed. These are four in number :—

1. To break up the attack.

2. To hold the attack under the close fire of the defence.

3. To direct the attack into avenues of approach which may be more advantageous to the defence.

4. In some special circumstances, to deny dead ground to the attack.

The third head deals with the details of construction of obstacles, and is so very closely connected with the purposes for which they are constructed that I propose to take these two heads together. The principles which govern the construction of obstacles are as follows :—

(1). They should exhibit an intelligent use of the material available.

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(2). They should be so strongly made that a special effort is necessary to remove or destroy them.

(3). The material chosen must not give cover to the enemy.

We want to break up, hold, and divert the attack. The first thing to do is to look round and see what material is available. Now the question of material is important. There is no doubt that to the Army generally there is only one material—" barbed wire," in fact barbed wire is almost a creed with all ranks, and its popularity may be said to be universal, as proved by its use even by suffragettes in the defence of their platforms. I date this popularity from the days of the South African War when the blockhouse wire fences stretched as far as the eye could see, and the supply of wire was apparently inexhaustible.

Barbed-wire fences *were* certainly provided for innumerable posts, every line of blockhouses, and along miles and miles of railway, so that at the end of the war there was something between 50,000 and 75,000 miles of barbed wire available for the Boer farmers to re-fence their farms with, and there is little doubt that nearly every officer and man of the Army in South Africa had been intimately connected, in one way or another, with this material. As a matter of fact the supplies of barbed wire in South Africa were by no means inexhaustible, the local supplies in what may be described as a barbed-wire country lasted but a few weeks, and our demands on the home market could never be met without great delay.

Just after the South African War came the Siege of Port Arthur, with its lurid tales of the ceaseless storming of barbed-wire entanglements by the Japanese; and later on similar tales were told of Adrianople (these latter were mostly fables). With these object lessons, no wonder that all ranks still think in " Barbed wire," and that the letters B.W.E. are so frequently met with in all paper schemes of defence. " It's so simple " to put a lot of criss-cross lines on paper, and put these letters against them, with a note added " Obtained locally."

But what are the real facts of the case? Take an average piece of country—how much barbed wire is there to be seen? An odd strand in a hedge, perhaps a short length of two or three strands well bedded into growing stakes. The extraction of this wire is a matter of some considerable difficulty, and when it has been got out, it is the very devil to use. Anybody who has had to use second-hand barbed wire of this nature shies at it as badly as did the Boers when it was offered them for almost nothing for fencing their farms. Again local stores are no good. It was ascertained that the whole of the stocks in an ordinary country town amounted to less than 1 ton or 20 rolls, and enquiries during the manœuvres of 1913 proved that the total stocks of one of our large cities amounted to only 20 miles or 100 rolls.

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It is therefore clear that we must try to get barbed wire out of our minds and look for something else if we want to make obstacles.

The resources of the country are therefore reduced to the material of the fences such as quick-thorn hedges, hop poles and hop-pole wire, perhaps some sheep hurdles, and nut bushes. Abattis made of quick-thorn hedge or nut bushes can be made an effective obstacle if it is of sufficient depth to prevent an armed man from clearing it in one jump, and strongly picketed down to prevent any chance of removal. This must be insisted upon. The depth should be from 12 ft. to 15 ft. and all pickets used should be really strong, about 2 ft. 6 in. long and 3 in. thick, and be driven till the fork at the head takes the ground. The usual run of picket provided by a military working party is a wretched affair, too weak to be driven, too short to hold, and too small in the forked head. Hop poles will make a *chevaux de frise*, or pointed stakes driven in the ground at close intervals will offer sufficient resistance to make a check in a rush; this is a revival of the tactics of the days of the English archers. Sheep hurdles and jubilee fences placed in rows at 5-ft. interval will, if firmly picketed down also form an efficient check to a rush. Brushwood hurdles cannot be used except in very favourable circumstances owing to the cover they give. All the above can be made very much more efficient if barbed wire taken in short lengths from the hedges is intelligently introduced. Hop-pole wire though plain is most valuable in making the abattis, etc., difficult to move.

With reference to concealing the obstacles of a hasty defence scheme :—There is no doubt that something in this line can be done by judicious siting from the attacker's point of view. Taking advantage of folds in the ground, placing them behind a line of fence, but I very much doubt whether the expedient of sinking them in the ground as outlined in the *Manual of Field Engineering* could ever be carried out except in very deliberate work. The destruction done by artillery fire to obstacles is not very serious. The Bulgarian shells at Adrianople were found to improve the wire obstacle.

The use of obstacles to deny dead ground which I mentioned has been applied in the manner shown in *Fig.* 1. *Fig.* 2 shows how the interval between New Pound and Highlands could have been defended on this principle.

Let us now consider the obstacles from the point of view of the attack.

We will assume that the field of fire is only 150 yards, which in a close country like this is not too pessimistic—and that at this distance orders are given for the assault. The officers and men see the obstacles in front of them. Will the G.O.C. order the destruction of the obstacles prior to the assault ?

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FIG. 1.

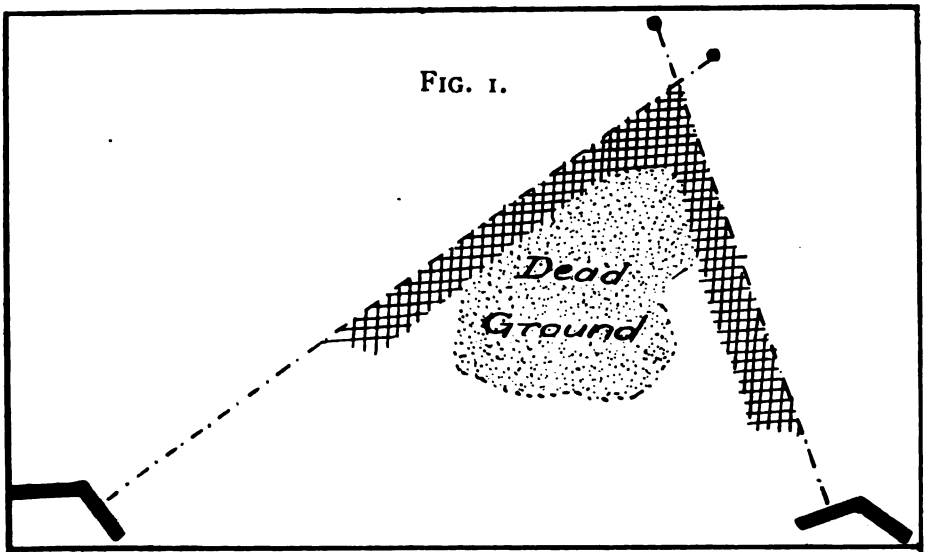
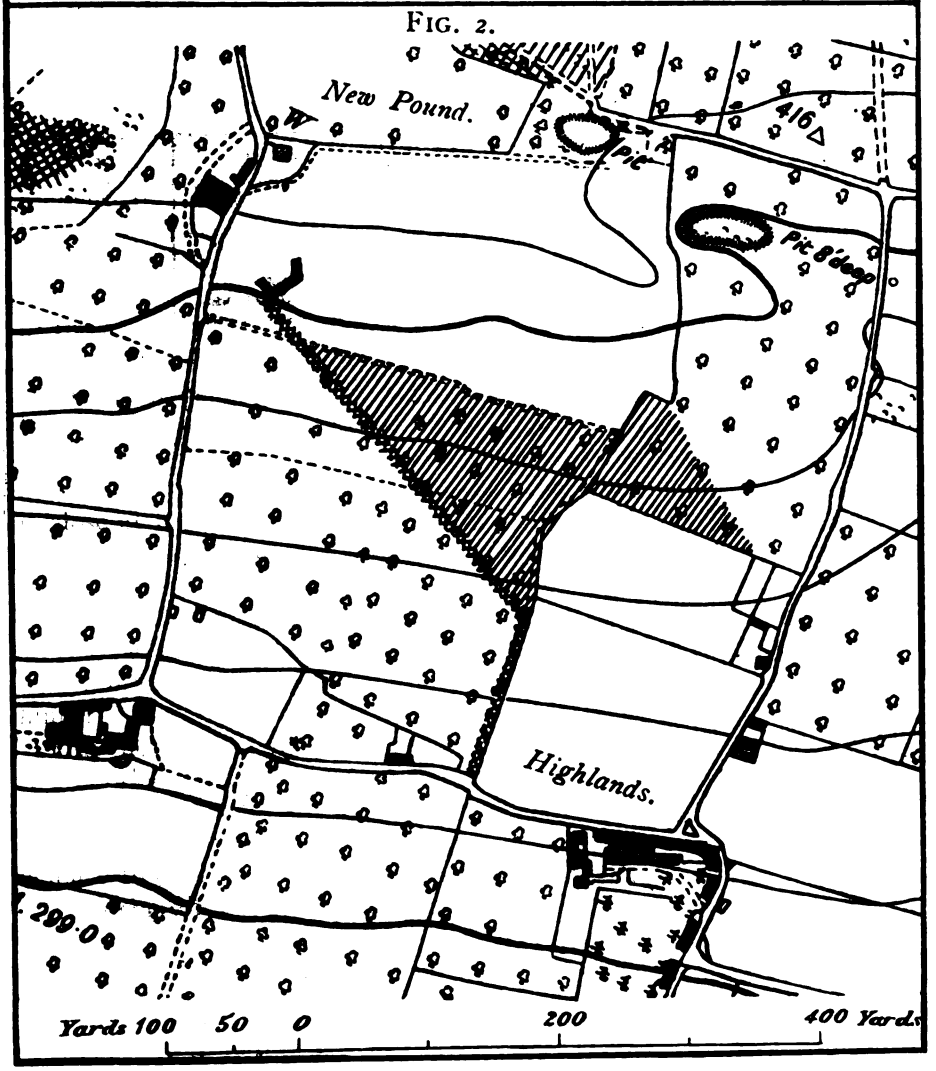


FIG. 2.



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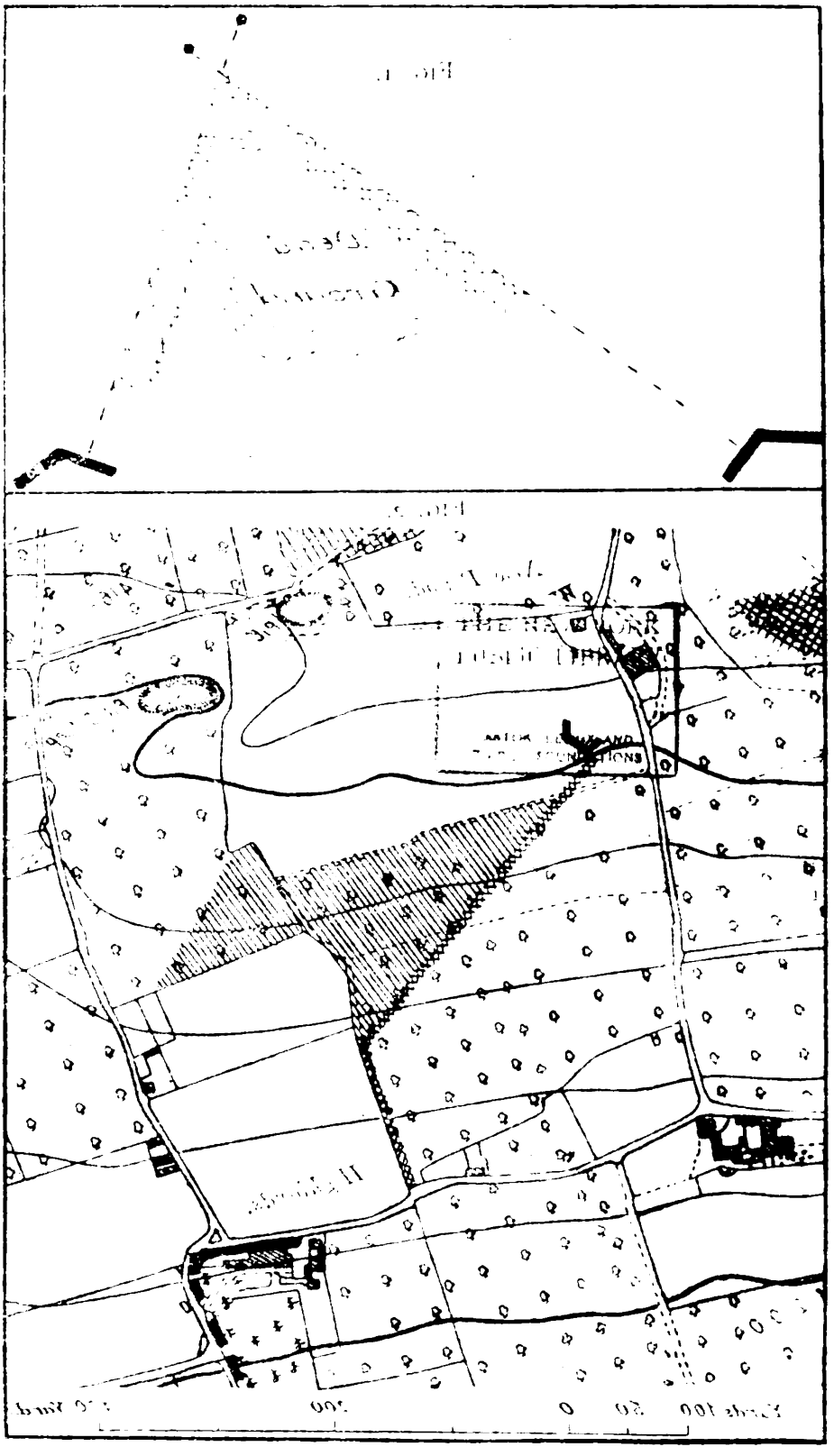

It is stated in the *F.S. Regulations* that the R.E. should be pushed forward to clear obstacles, but will the appearance of a field obstacle such as I have described above be sufficient excuse either for the almost certain decimation of the R.E. with the advanced troops, or the delay thus imposed on the assault, while the R.E. perform their task ?

Will not a G.O.C. think twice about risking his skilled workmen when he may want them for far more important work later on in the campaign ? Besides the feelings of the infantry have to be considered. The view of these field obstacles is by no means discouraging to them. They have also made these things in peace time and think they know their worth.

Let us now try to picture what part our field obstacle will play in the assault. First of all there will be a tendency of the men to edge off towards the intervals which will become more or less crowded. The troops who have to cross the obstacle probably rush and jump. Some individuals may clear the lot and continue their rush, but those who cannot jump well or do not get a clear run at it, land in it, and once in it the sting is taken out of their charge. Men who are wounded fall and struggle to rise, upset their comrades, and thus increase the efficiency of the obstacle which becomes slippery with blood, and thus generally speaking our obstacle is doing its job of delaying and holding the enemy under the close fire of the defender.

The delay caused at the obstacle prevents that perfect cohesion of the attack which gives success, for the troops at the intervals will not wait for those entangled in the obstacles at such short ranges ; these again being probably rather crowded and affording a good target will have been subjected to the attentions of the machine guns of the defence. It seems therefore fair to assume that our obstacle has tended to break up and divert the attack, and the local reserve is close at hand to throw it back whence it came. In such circumstances there is no doubt that the existence of an obstacle has been justified.

Take the case when the assault has a clear run at the defence works. 150 yards should be covered in 30 seconds, and with no check intervening can the defence stop a determined assault within this limit ?

I do not intend to dwell on the construction of obstacles for siege works—their purposes are the same, but with time and resources they can be made practically impregnable, or at least strong enough to induce such delay to the attack that sufficient time is given for the defence to develop any further resources it may possess.

The deep ditch is still the most formidable of permanent obstacles, but the ditch must be provided with flanking fire. This was most forcibly impressed on military engineers by the experiences of the Russo-Japanese War.

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Other forms of permanent obstacles are the palisade, optimistically described as unclimbable. This can be seen in various forms round W.D. property. It varies from 5 ft. 6 in. to 9 ft. in height, and barbed-wire entanglements take their place even in permanent work. I have heard that the entanglements round some German fortresses are 100 yards wide, those at Adrianople were 30 ft. wide.

As regards the crossing or destruction of these permanent obstacles, the lesson of the Russo-Japanese War is that the ditch can only be crossed by the systematic attack by sap and mine conducted first against the counterscarp, then across the ditch to the escarp, and when this is destroyed then the attack has some chance of entry. Palisades can be cut by explosives.

You have already seen some ideas as to how the barbed-wire obstacle can be crossed or destroyed. You have seen that there are three ways of dealing with the problem, over, under or through. I cannot believe that any passage over the obstacle can be effected except when the enemy is thoroughly demoralized, or when the obstacle has been so badly placed that it is not under close fire from the infantry parapet. The passage through may sometimes be effected by judicious use of explosives, but too much trust should not be placed on the effect of the artillery shells—the effect of 6-in. shells at Adrianople was rather to improve the obstacle.

The Siege of Adrianople does not throw any fresh light on this subject of crossing wire. I have been informed from a second-hand source that the 10th Regiment of the Bulgarian Army which captured the dominating point (Fort Ayi Yolu) in the section of the defences the Bulgarians attacked, were fortunate enough to strike a place in the wire entanglement which had been meant to allow egress for a sortie, and this was closed by a barricade which was not under fire. The removal of the barricade enabled the whole of the regiment to pass through the obstacle. It is stated that other regiments who were not so fortunate were held by the barbed wire, and only crossed it when the Turks' line was rolled up.

There remains the way under, by which the entanglements may be destroyed by mining. This, I think, will be the way of the future, for it is difficult to imagine any troops again facing the carnage wrought at Port Arthur.

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SOME NOTES ON THE ORGANIZATION AND EQUIPMENT OF THE ENGINEERS OF FOREIGN ARMIES AS COMPARED WITH OUR OWN.

By LIEUT. K. J. MARTIN, R.E.

THE terms organization and equipment suggest long tabular statements and many figures. In the preparation of this article it has been difficult to avoid making it a recitation of a string of figures and hard uninteresting facts, giving the numbers of men, horses, and tools which each nation think it fit to include in the engineers of its army.

An attempt has been made, therefore, so to digest the matter of data collected, in such a manner as to convey some idea of the position of the engineers in foreign armies as compared with our own Corps. Further, it is proposed to investigate what each country expects of its sappers in the light of their organization, and how far they are likely to attain their object as indicated by their equipment.

Before comparing any foreign army with our own, it is necessary to remind ourselves of the vast difference in the conditions of service between them. We must remember that every foreign army, except that of the United States, is raised by some form of conscription. As a result, we have to deal with very much larger numbers than we are accustomed to at home, and for this reason the war and peace strengths of the principal European Powers which most directly interest us are shown in Table I. The war strengths shown in each case are the total numbers available. It must not be thought that these are the numbers which would be put in the field on mobilization at the outset of a campaign. They represent the total number of trained or partly trained men available for war. That is, they include contingents for filling up the gaps in the first line army caused by the wastage of war, and men for the second and successive lines of defence.

The terms of service in France are three years with the colours, and obligation to serve in the various branches of the Reserve and Territorial Army for 25 years till a man's 50th year. In Germany service with the colours is for two years and liability to service continues till the 45th year of the man's age. In Russia the engineer has to serve four years with colours, as compared with three years in the case of the infantry.

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TABLE I.

STRENGTH OF ARMIES.

Austria.—War	———	2,265,000
Peace	—	425,365
Belgium.—War	—	200,000
Peace	-	50,000
France.—War	———	3,878,000
Peace	——	608,000
Germany.—War	———	4,186,000
Peace	——	693,000
Holland.—War	—	176,500
Peace	-	33,000
Italy.—War	———	1,214,000
Peace	—	242,375
Russia.—War	———	5,529,700
Peace	———	1,209,600
Gt. Britain.—War	———	800,000
Peace	—	250,000

In Table II. is shown the percentage of engineers in an army corps of each of the principal foreign armies. From it we can gauge the importance attached to the sapper by each nation. It is noteworthy that the proportion of sappers to other arms in the organization of the German and British Armies is almost identical.

So much for the general survey of conditions.

TABLE II.

PROPORTION OF ENGINEERS IN AN ARMY CORPS.

Austria	60,000	1,226	2·02%
France	36,500	1,913	5·24%

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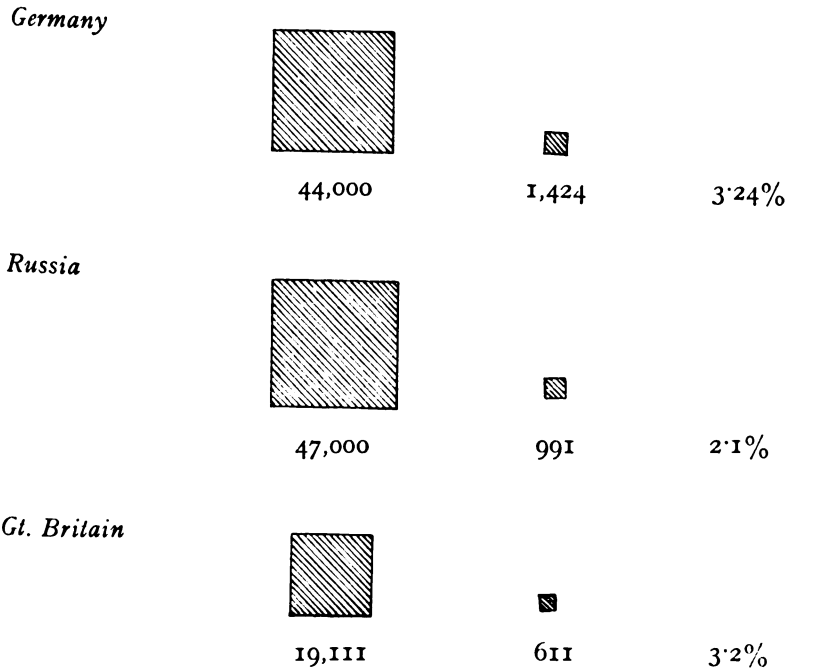

The engineers of foreign armies usually comprise the following branches :—

(*a*). Field Pioneer Battalions.
(*b*). Bridging Trains.
(*c*). Field Engineer Parks.
(*d*). Telegraph units } Communication Troops.
(*e*). Railway units }
(*f*). Siege and fortress units.
(*g*). Submarine-mining units.
(*h*). Aeronautical formations.
(*i*). Pigeon post.

Time does not permit us to go fully into every branch of the Engineer Services, so I propose to consider, only, those units which are normally attached to an army corps in war, whose position is similar to our own in a division of the Expeditionary Force, and consequently whose *rôle* we are more likely to appreciate. Further, we cannot obviously go into the conditions prevailing in every foreign army, and we will, therefore, confine ourselves to the three largest armies, viz. France, Germany, and Russia, about which I have been able to obtain most information.

Tables III. to VI. illustrate the engineer formations normally allotted to a division or army corps of the field army.

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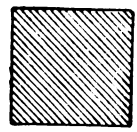
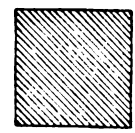
TABLE III.

GREAT BRITAIN.

ENGINEERS IN A DIVISION.

C.R.E.'s Staff :—	4 Officers.	10 Other Rank.
2 *Field Coys.* :—	6 Officers.	211 Other Rank.

25 yds. Bridge (each).

1 *Signal Coy.* :—	6 Officers.	157 Other Rank.

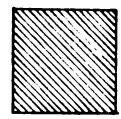
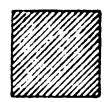
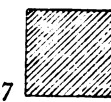


TABLE IV.

FRANCE.

ENGINEERS IN AN ARMY CORPS.

1 *Battn. Sappers* :—	Battn. Staff.	15 O.'s.	32 O.R.

258 247 247

A.C.H.Q.'s. Divl. Divl

3 Coys. :

Pontoon Coy. :—	5 O.'s.	46 Sappers. 190 Drivers.

140 yds. Bridge.

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Engineer Park :— 3 O.'s. 21 Sappers. 68 Drivers

Detachment of Engineer Cyclists :—

Varying in Strength.

Bicycles Fitted to Carry Light Tools.

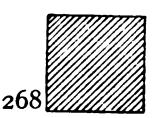
Telegraph Coys. :—
Railway Coys. :— } Attached as Required.

Table V.

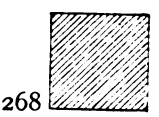
GERMANY.

Engineers in an Army Corps.

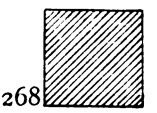
1 *Battn. Pioneers :—* Battn. Staff. 2 O.'s. 5 O.R.



A.C.H.Q.'s.



Divl.



Divl.

Divl. Bridge Trains :— Attached to Divl. Field Coys., O.'s. & Men from Train.

37·5 yds. each.

Corps Bridge Train :—

136 yds. Bridge. **6 O.'s. 138 O.R.**
2 O.'s. 64 O.R.

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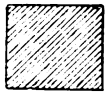
Corps Telegraph Detachment :— 8 O.'s. 161 O.R. (**37**).



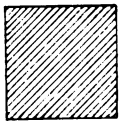
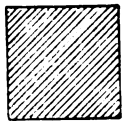
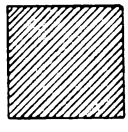
Telephone Detachment :— 1 O. 35 O.R.

TABLE VI.

RUSSIA.

ENGINEERS IN AN ARMY CORPS.

1 *Battn. Pioneers :—* Battn. Staff 7 O.'s. ? O.R.

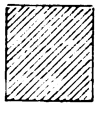
4 O.'s. 237 O.R.

3 Field Coys.

23 yds. Bridge (each).

Engineer Park :— 1 O. 45 O.R.

Telegraph Coy. :— 7 O.'s. 209 O.R.



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FRANCE.

Field Company (War).

	Officers.	Men.	Vehicles.			Tools.
			1-horse.	2-horse.	6-horse.	
Captain	1		1	2	2 tools.	114 shovels.
Subalterns	3		explosives	baggage		50 pickaxes.
"Adjutant" ..	—	1	(1,000 lbs.)	and		12 picks.
Colour-Sergeant ..	—	1		supply.		44 axes.
Sergeants	—	18	1 pack			30 billhooks.
Corporals	—	17	mule.			30 saws.
Master-Workmen ..	—	16				10 wire-cutters.
Hospital Orderlies ..	—	5				700 135-gramme petards.
Cyclist	—	1				
Tailor and Shoemaker	—	2				290 100-gramme cartridges.
Buglers	—	2				
Sappers	—	180				
	4	243	1	2	2	

The Army Corps Field Company has in addition 1 captain, 1 corporal, 9 drivers.

From the above table it is evident that the French field company cannot be split up into independent sections as is possible with our own. The limited transport prevents this being the case.

It is noteworthy that all the explosive carried by the company is carried in one cart. One lucky shot into this cart would apparently mean a serious loss to the company.

Further 1 cyclist per company, as compared with the 33 we have, must considerably diminish the range of action and mobility of the French unit. This is, presumably, made up for by the cyclist detachment which would be under the orders of the C.R.E.

FRANCE.

Pontoon Company (War).

	Officers.	Men.	Vehicles.		Tools.
			2-horse.	6-horse.	
Captain ..	1			Divisions (2).	45 shovels.
Subalterns ..	2			20 pontoon wagons.	23 pickaxes.
V.O. ..	1			14 G.S. (bridging stores).	34 picks.
Administrative Officer ..	1			2 tool forges.	14 billhooks.
Rank and File		46		Reserve.	4 saws.
Drivers ..		190		1 pontoon wagon.	
				1 G.S. (bridging stores).	
				Train.	
			6 baggage and supply.	1 field forge.	
				1 G.S.	
				1 forage.	
Total ..	5	236	6	41	

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Each company is divided into 2 divisions, a reserve and the train transport. Each division is divided into 7 sections, viz., 1 abutment wagon, 1 trestle wagon, 4 pontoon wagons each carrying 2 pontoons, 1 forge wagon; and can build a bridge 70 yards long.

Note.—In the French cavalry there is no brigade or divisional bridging equipment; each cavalry regiment carries in one wagon two metal boats.

FRANCE.

Army Corps Engineer Park (War).

			Vehicles.				Tools.
			1-horse.	2-horse.	4-horse.	6-horse.	
Captain ..	1		1 telegraph.	2 baggage and supply.	1 field forge 1 G.S. (spare).	9 tools. 2 spare tools. 1 ropes & bridging stores. 1 explosive	45 sledge-hammers. 106 saws. 640 spades. 20 hand spades. 20 small picks. 1,575 round shovels. 259 square shovels. 995 pickaxes. 144 picks. 424 axes. 495 billhooks. 94 wire-cutters. 1,600 135-gramme petards. 1,728 100-gramme cartridges.
Subaltern ..	1						
Admin. Officer	1						
Rank and File		21					
Engineer Train :—							
" Adjutant "		1					
Sergeants ..		2					
Corporals ..		5					
Bugler ..		1					
Farrier ..		1					
Saddler ..		1					
Drivers ..		57					
	3	89					

Remarks :—

(1). The above constitutes a reserve in the field unknown in the British Army; either to replace lost tools and expended explosives or to provide additional material for any large works that have to be undertaken.

(2). Note the spare vehicles.

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FRANCE.

Telegraph Company (War).

Attached as required.

	Officers.	Men.	Vehicles. 1-horse.	Vehicles. 2-horse.	Vehicles. 4-horse.	
Staff.						
Captains	2		6 cable drum.	6 post.	1 field forge.	Each company has about 460 k.m. (287 m.) of cable, 1,244 telegraph poles and 24 helios.
Subalterns	2			12 telegraph.	1 rack.	
Colour-Sergeant ..		1		12 G.S.	10 cable.	
Q.M.S.		1		2 baggage and supply.	3 telegraph poles.	
Hospital Orderly ..		1				
Cyclists		4				
Detachment of Engineer Train.						
Subaltern	1					
Sergeant		1				
Corporal		1				
Farriers		2				
Drivers		14				
			6	32	15	
Sections (6)						
Subalterns	6					
"Adjutants"		6				
Sergeants		18				
Corporals		24				
Cyclists		24				
Buglers		6				
Sappers		192				
Engineer Train :—						
Sergeants		6				
Corporals		12				
Drivers		48				
Material Section.						
Sergeants		2				
Corporals		5				
Cyclists		2				
Sappers		11				
Engineer Train :—						
Sergeants		2				
Corporals		5				
Farrier		1				
Drivers		26				

Totals :—Officers, 11 ; men, 415.

Notes on the French Signal Service.

Visual signalling is very little practised. Semaphore signalling is taught ; but it is found that though the men pick it up quickly, they forget it still more rapidly.

Each infantry battalion is equipped with lamp and helio signalling apparatus ; but the rate of working is very slow.

The employment of telegraphs and telephones is limited to connecting divisions and higher units. Each brigade has a telephone detachment for communication with the divisional commander, but little reliance is placed upon it, partly because of the idea that in war the wires are liable to be cut or otherwise interrupted, but

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chiefly owing to the French system of *agents de liason* giving such excellent results.

The French consider that cyclists and motor-cyclists are too easily captured to form a reliable means of communication.

The *agents de liason* are orderlies and officers sent by each unit to the unit above it to maintain communication with it.

GERMANY.

Pioneer Field Company (War).

Officers, 6. Horses, 20.
Other ranks, 262. Vehicles, 7.

Vehicles :—3 2-horsed, 1 4-horsed } pioneers' stores.
1 baggage wagon, 1 supply wagon, 1 field kitchen } 2-horsed.
1 pack horse.

Organized in three " self-contained " sections.

Horses and vehicles are all supplied by the train. There is no mounted branch in a German field company.

No bridging material is carried ; the whole of this being concentrated in the divisional and corps bridge trains.

Armament :—1898 Mauser rifle with pointed bullet. Sword-bayonet with special pattern saw-back.

The men carry a kit of 60 lbs. including a tool and 150 rounds.

Principal tools :—

	Portable.	In Wagons.	
Picks ..	.. 57 ..	.. 4	Besides car-
Shovels ..	.. 99 ..	.. 8	penters' and
Axes ..	.. 57 ..	.. 20	smiths' tools,
Hatchets	.. 21 ..	.. 4	etc.
Wire-cutters	.. 6 ..	.. 30	

Explosives (trinitrotolnol) :—Has the same effect as picric acid, but insoluble in water and safer to handle.

Remarks :—

(1). The number of cyclists per company is not given.

(2). The marching order is the same as for infantry. Its great weight must impede mobility, and limit the working power.

(3). The small number of horses must restrict mobility. Also very few horses are available for carting materials for field defences. Compare the British field company with 77 horses.

(4). The so-called " self-contained " sections hardly agree with the British ideas on the subject.

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GERMANY.

Searchlight Section (Organization ?).

No. 1 Light :—1 Officer, 1 N.C.O. and 4 men, 1 projector carriage with limber containing motor and dynamo, drawn by 6 horses.

No. 2 Light :—Same as above.

Projectors :—60-c.m. Schuckert with parabolic reflector of silvered glass, mounted on telescopic steel mast, range of elevation 9 ft. to 22 ft. Concentrated beam.

Lamp :—Automatic Schuckert (horizontal); with small arc deflector. Size and nature of carbons not stated; 60 volts with 60 amps.

Limber :—Contains 2 cylinder 6-H.P. benzin motor, with automatic carburettor and magneto ignition, driving a small dynamo at 6,000 revs (?) per min., 2 insulated copper cables 100 m. long connecting limber to projector carriage. These cables are wound on drums on either side of mast.

Weight behind team about 35 cwt.

Time required for changing reflectors 20—30 mins., which shows that spare backs ready fitted with reflectors are not carried.

The lamps are really automatic, burn steadily, and the carbons have rarely to be adjusted.

Note.—These searchlights were used in 1910 Pioneer Manœuvres. According to 1913 establishments one section is to be included in each pioneer field company.

Portable searchlights are carried on a store wagon. They are on the Kamm system with 30-c.m. projectors.

Tradesmen in a German pioneer battalion in peace :—

Among 508 N.C.O.'s and men :—

160 boatmen and boat builders,
164 carpenters,
16 miners,
70 men of the iron trades,
30 masons,

the remainder being made up of telegraphists, saddlers, and men of no particular calling.

The men do not have to reach any standard of trade qualification and many of them have but a smattering of knowledge of their so-called trade.

GERMANY.

Divisional Bridge Train.

Officers, 2 } from Train. Horses, 98.
Men, 59 } Vehicles, 21.

It is attached to the pioneer field company of the division, and is under the command of the officer commanding that company. On the march this latter officer details one pioneer for every vehicle of the bridge train to look after the bridging material.

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Vehicles :—

1 shore transom wagon.
2 trestle wagons.
12 pontoon wagons.
1 tool wagon.
1 store wagon.
2 forage wagons.
1 baggage wagon.
1 supply wagon.

Pontoons are of galvanized steel and are bipartite. Bow pieces differ from stern pieces in that they have raised bows to give extra safety in rough water. A single pontoon will ferry 18 men; 2-pontoon raft 60 men, or 7 men and 7 horses, or field gun with 4 horses and 8 men.

Remarks :—

(1). Bridge can be constructed with the men who can be transported on the wagons (seats for four on each), though there would be slight delay as the number of men is insufficient to unload simultaneously with construction.

(2). The *personnel* of the divisional field company is sufficient for the rapid construction of the bridge, but does not allow of a reserve.

(3). Trestles are of Weldon pattern.

(4). Pontoons are carried bottom upwards which prevents men sitting in them on the wagons. They are very visible at long ranges owing to plate steel not being painted.

Bridging capacity :—

A normal bridge is designed to take all weights up to 3·14 tons. For 21-c.m. mortars, long 15-c.m. guns and all vehicles weighing between 3·14 and 4·92 tons, normal bridge is strengthened by doubling the baulks under the wheel tracks. For the army mechanical transport trains (greatest weight on each back wheel of tractor, 3¼ tons) the bridge must be constructed with twice the number of pontoons required for normal bridge, the number of baulks is increased from 5 to 9 and the chesses are doubled.

This type of heavy bridge may be used by fully loaded mechanical transport trains across rivers with a velocity not exceeding 5·1 miles per hour.

Nature of Train.	Bridge.			Time of Construction.	No of Pioneer Companies required.
	Light.	Normal.	Heavy.		
	yds.	yds.	yds.	hrs.	
1 Divisional bridge train ..	44·8	37·5	12	½—1	½—1
1 Corps bridge train ..	169·5	136	82	3	1—2
1 Corps bridge train and 2 divisional bridge trains..	257	214·5	121·3	5	2

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GERMANY.

Corps Bridge Train (War).

Officers { 2 / 6* } Horses, 239.

Men { 64 / 138* } Vehicles, 39.

It is composed of a pioneer detachment and a train detachment, and is under the command of the captain of the train detachment.

Vehicles :— 2 trestle wagons, 26 pontoon wagons } 6-horse.

2 store wagons
2 tools wagons
1 demolition (explosives) wagon
4 forage wagons } 4-horse.

1 baggage wagon
1 supply wagon } 2-horse.

Pontoons are galvanized steel whole pontoons, 26¼ ft. × 4 ft. 11 in. × 2 ft. 9½ in. and weighing about 1,102 lbs. Their buoyancy is practically the same as that of the bipartite, viz. 7¾ tons with a free board of 3½ in. Each pontoon or trestle wagon carries a complete bay of superstructure.

Note.—It is curious from British point of view that a Bridge Train, which is a pioneer unit, should be commanded by a train officer.

GERMANY.

Corps Telegraph Detachment (War).

Officers, 6. Horses, 73.

Other ranks, 161 (37 belong to the train).

Vehicles :—16 2-horse material and store wagons.
4 2-horse station wagons.
1 2-horse baggage wagon.
2 motor cars.
16 cycles.

Organized in four sections of equal strength and identical equipment. It provides communication between A.H.Q. and Army Corps and Divisional H.Q. (when this latter has not been effected by the telephone detachments).

Each section carries 3 field telegraph apparatus, and 9 telephones ; also 13½ miles of insulated cable, 12½ miles of insulated wire, and ¾ mile of bare wire. It can lay 11 miles of line at a speed of 1,100 yards in 30 mins. ; and can establish 2 to 3 stations for simultaneous Morse and telephone traffic, and 3 telephones in addition.

All the men of the detachment can find room on the material wagons for rapid transport when necessary. Sections can move at a trot.

* Train.

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Notes on Signalling in the German Army.

Visual signalling has not hitherto been treated seriously in the German Army. There is no School of Signalling, and what instruction is given, is carried out under regimental arrangements when opportunity offers.

New Flag Signalling Regulations appeared in 1904 pointing to the fact that increased attention is being paid to this method of communication.

In each company of infantry there must be 1 officer and 2 N.C.O.'s capable of acting as instructors. The following men must be trained as signallers :—All bandsmen ; trumpeters of the field artillery.

In the infantry, cavalry, field artillery and pioneers—6 men per company, including those trained in telephone duties.

In the communication troops 12 men per company.

A rate of signalling of 2 words a minute is aspired to with both lamp and heliograph. These are only carried by the cavalry.

Orderlies are much used.

GERMANY.

Telephone Detachment (War).

Officers, 1. Horses, 17.
Other ranks, 35. Vehicles :—3 2-horsed material wagons.
1 2-horsed store wagon.

Organized in 3 squads, each consisting of 1 mounted telegraph N.C.O. and 5 or 6 men ; the whole detachment being under the command of a lieutenant.

Each squad carries 5 miles of telephone cable and 4 telephones with batteries ; these stores are carried on a material wagon on which the men of the squad are transported. Each squad can lay 4 miles of line in about 2½ hours, and can establish 4 telephone stations.

Telephone detachments will probably be allotted to the H.Q.'s of army corps and divisions.

RUSSIA.

Field Company (War).

Officers, 4.
N.C.O.'s, 20.
Sappers, 217, 17 of which are non-combatants.

First line transport :—

3 store wagons containing :—
40 shovels.
18 picks.
40 axes.
2 saws.
100 sandbags.
Wire and special tools.

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The men carry on the person the following tools :—

100 shovels.
30 picks.
70 axes.
8 saws.
4 augers.
8 carpenters' chisels.

The divisional field companies carry the following bridging equipment :—6 3-horse wagons carrying 2 trestles and 4 half-pontoons and superstructure, giving 23 yards of normal bridge.

RUSSIA.

Engineer Field Park (War).

Constitutes a mobile reserve :—

(1). To supplement the tools carried by the infantry and field companies when especially large works have to be undertaken.

(2). To replace lost and expended stores.

Establishment :—1 subaltern.
45 men.

Principal tools carried :—

2,700 shovels.
582 axes.
212 picks.
350 sandbags.

Note.—(1). No mention is made of demolition stores such as explosives ; presumably a reserve of these is also carried to make up for expended materials.

(2). Tools carried by an infantry company :—

On the men—140 small shovels, 30 picks, 30 handaxes.

Company reserve—16 large engineer shovels, 6 picks, 8 axes.

RUSSIA.

Telegraph Company (War).

Officers, 7.
N.C.O.'s, 54.
Sappers, 155.

Organized in 3 sections :—

2 airline, with 16·9 miles of line each.
1 cable, with 23·1 miles of cable.

The company has sufficient men and material for 12 telegraph stations, as well as for 6 stations for visual signalling.

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It is stated that the cable is specially used when communication has rapidly to be established or in the immediate neighbourhood of the enemy, or when the ground is too hard for the poles of the air line to be driven in.

Notes on Communication.

(1). Russia has 13 mounted orderlies per regiment.

(2). Not much importance is attached to visual signalling, except in mountain warfare and for the passing of conventional signs between skirmishing lines.

(3). They possess excellent telephones and make much use of them. Each infantry regiment has a telephone detachment of 12 men. The telephones are carried in carts; and the line is laid by dismounted men.

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SIEGES AND THE DEFENCE OF FORTIFIED PLACES BY THE BRITISH AND INDIAN ARMIES IN THE XIXth CENTURY.

(*Continued*).

By COLONEL SIR EDWARD T. THACKERAY, V.C., K.C.B. (LATE R.E.).

THE SECOND SIEGE OF BHURTPORE, 1825.

Towards the close of the year 1824, trouble again arose in the Native state of Bhurtpore, not far from Agra, through the usurpation of the "gaddi" by one Doorjan Lal, who imprisoned the rightful heir, recognized by the British on the death of the Rajah, Runjert Singh of Bhurtpore.

Sir David Ochterlony, well knowing the temper and intrigue of which this city was the centre, collected a force at once, and moved against Doorjan Lal. Lord Amherst, however, ignored the danger, and refused to ratify Sir David's action, and ordered him to withdraw and break up the army. This gave Doorjan his opportunity, which he made the most of, in collecting arms, powder, artillery, and sending round messages to the Central Indian States to support him. He soon made his position exceedingly strong; and relying on the prestige of the invulnerability of his fortress (gained 20 years before when it withstood four assaults by Lord Lake's Army which lost 3,000 men in futile efforts), he now defied the British openly. This constrained the Government to take vigorous action, before he was actually joined by the other states, who were ready to move, but who were then merely looking on. In December, 1825, therefore, a force of some 27,000 men, with a large siege train, moved against Bhurtpore, under Lord Combermere, then Commander-in-Chief; and by the 11th of that month the city was invested by a cordon 15½ miles long. On the 18th of December, three companies of Goorkhas (Sirmoor Rifles) reached Muttra, which was held by some of our cavalry, and next day joined the camp of the main army before Bhurtpore. The same high mud walls which had baffled Lord Lake still surrounded the city, and the Motee Jheel still supplied water to the moat. Guns innumerable crowned the walls, and 25,000 Jats, Pathans and Rajputs defended the city, with its immense store of treasure.

The first act in this siege was a fortunate one, for a rapid move of a portion of Lord Combermere's left wing surprised the enemy in the act of cutting the dam which admitted the waters of the Motee

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Jheel into the moat, and thus prevented it from becoming a terrible obstacle.

Nine days were spent in survey and reconnaissance which resulted in the Commander-in-Chief's decision to attack from the east, while making a feint of coming from the south-west as Lord Lake had done.

Under cover of this feint the cordon was drawn still closer, two important positions were taken up, and parallels were opened some 600 yards from the walls.

The duty of reconnoitring and seizing the "Kaddam Kandi," a temple situated in a wood within 400 yards of the so-called "Long-Necked Bastion," was carried out by a column consisting of the Grenadiers of the 59th Foot, five companies of the 21st Native Infantry, 100 of the Sirmoor Battalion, two troops of cavalry, and two howitzers. On reaching the wood, the Goorkhas were sent forward to clear it and hold the further edge, while a passage was dug through some banks for the guns.

The enemy retreated at once, and a heavy but ineffective fire was opened from the walls. The Goorkhas were then sent forward to reconnoitre the ditch, while the 59th replied to the fire from the temple walls and banks. The reconnaissance completed, the Goorkhas were withdrawn to hold the "Kaddam Kandi" Temple with the 59th. At the same time 100 men of the Sirmoor Battalion, under Lieut. Kirke, attached as skirmishers to General Reynell's Column of the 14th Native Infantry and 23rd Native Infantry, operating to the right of the first-named column, were successful in obtaining possession of a walled garden and in repulsing a vigorous sortie from the Soorajpur Gate with slight loss. These two positions now formed our advanced posts, and were held by the Goorkhas almost throughout the operations.

The first parallel was commenced on the 23rd December, and the following day all women and children, other than those of the Royal Family, were allowed to pass out; at the same time a force of cavalry from the city succeeded in cutting their way out through our lines.

The regular siege now opened, the Goorkhas acting as covering parties and holding the advanced posts.

On the 26th it appeared as if the enemy's guns were more or less silenced, and the second parallel was opened within 250 yards of the ditch, while on the 28th December the approaches were almost within 20 yards of the moat. But the enormously strong earth walls defied our hammering. On the left of General Nicholls' column 14 heavy guns had battered one of the curtains for nearly a week without making any impression, and the same thing had happened at the other points we hoped to breach, in spite of the large number of heavy guns brought to bear on the place—every siege gun in Upper India having been collected for the purpose.

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So on the 6th January, 1826, resort was found necessary to mining. The bombardment, however, continued till the 17th January to distract attention from this new work. Parties of the Sirmoor Battalion were continually used to guard those in the mines, and more than once our miners met those of the enemy countermining, when severe hand-to-hand fighting occurred; on one occasion a party of sixty of the enemy were surprised under the counterscarp by sixteen of the Goorkhas who killed a number of Jats. The naick of this party was promoted on the spot by Lord Combermere.

On the night of the 15th a mine was sprung to the left of the Long-Necked Bastion opposite which General Nicholls' column lay in their trenches. This was rumoured to have made a practicable breach, and Capt. Carmichael, the General's A.D.C., taking with him an Engineer officer, six of the 59th Grenadiers, and five of the Sirmoor Battalion, actually did manage to scramble to the top to reconnoitre and report on what they could see inside in the way of obstacles. This was done at noon when the enemy apparently were not very vigilant; the party gained the top, threw in some 50 hand grenades, fired three rounds, took a deliberate look well into the interior, before the astonished enemy recovered their surprise, and returned with the loss of only one grenadier. Later a similar piece of work was done at another reported breach by Havildar Mawanchand and 12 Goorkhas of the battalion, the former being promoted at once for the success of the undertaking.

The long-looked-for time for the assault was now close at hand. Another mine had successfully been sprung under a curtain in the Long-Necked Bastion, bringing down a mass of wall with some guns on top, and a huge mine of 10,000 lbs. of powder under the North-East, or Pathan Bastion, opposite General Reynell's point of attack, was completed on the 17th January. It was arranged that the firing of this mine was to be the signal for the final assault, which was to be in three main columns—General Nicholls against the breach in the Long-Necked Bastion, with two small columns, detached, one to attack the extreme left breach, the other, under Colonel Wilson, was to escalade at a point midway between the two great bastions; another, under General Reynell, was to assault the North-East Bastion; while on the extreme right a column under Colonel Delamain, with which was a detachment of the Nassera battalion, was to assault the Jugeenah Gate, which was partially breached. Lieut. Spottiswoode with 100 Goorkhas was to cover the advance of the Reserve Column under General Adams, who was to enter by the Muttra Gate immediately after the storm. Lieut. Kirke with the remainder of the Goorkhas was to cover General Reynell's stormers.

Before dawn on the 18th January, 1826, all the stormers were in their places in the advanced trenches, awaiting the springing of the

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mines, while the defenders, with an intimation of what was going forward, opened a heavy fire at daybreak. Word went down our line that all was ready. A mine at the Jugeenah Gate was sprung first, and then that in the counterscarp of the North-East Bastion, and all were awaiting the firing of the train for the demolition of that work. These explosions brought the garrison crowding to the walls, some 800 Pathans rushing to the parapets of the huge North-East Bastion, which it was their particular duty to defend. Immediately the mine under this with its 10,000 lbs. of explosives was fired; the ground heaved and rocked, and with a dull heavy roar half the bastion lurched and rose slowly in the air, followed by clouds of thick pungent smoke, carrying up guns, gabions, Pathans, banners, swords and matchlocks, to be strewn in their descent a mass of mangled flesh and broken metal. Three hundred of the defenders had been blown to pieces, and those in our advanced trenches also suffered somewhat, a number being hopelessly buried by the descending débris.

As soon as the smoke cleared away, with loud cheers Reynell's and Nicholls' stormers rose and dashed at their respective breaches, at the top of which the defenders fought desperately. They were, however, beaten back, and the entire line of hitherto impregnable walls was in our hands. Brigadier Edwardes, who led the assault at the Long-Necked Bastion had been killed, and the brigade suffered such losses that they could not penetrate beyond the bastion which they had won, till Fagan's Brigade arrived to reinforce them; then the whole swept forward into the city, and the place was soon in British hands.

Doorjan Lal managed to cut his way out through a cordon of the 14th Foot but was overtaken and captured by our British cavalry. The casualty list on the part of the enemy was reported as upwards of 13,000 of whom 4,000 perished in the assault alone; while the total British loss was 1,000.

In the Divisional Orders by General Nicholls, of the 19th January, 1826, he says: "The handsome and gallant advance of the 59th Foot was followed—indeed emulated—by the 31st Native Infantry, the Light Infantry of the 37th Native Infantry, the Grenadiers of the 30th Native Infantry, and the detachment Sirmoor Battalion. The service which fell to the troops was essential, and it was gallantly and effectively performed. Capt. Orchard, 37th, and Herring and Mercer, 35th, and Fisher's Sirmoor Battalion are requested to receive the Major-General's very best thanks for the exertions so cheerfully made by their respective battalions."

The army dispersed towards the end of January and a General Order later directed that the word "Bhurtpore" should be borne on the standards and colours of all the corps which were employed at the capture of that fortress.

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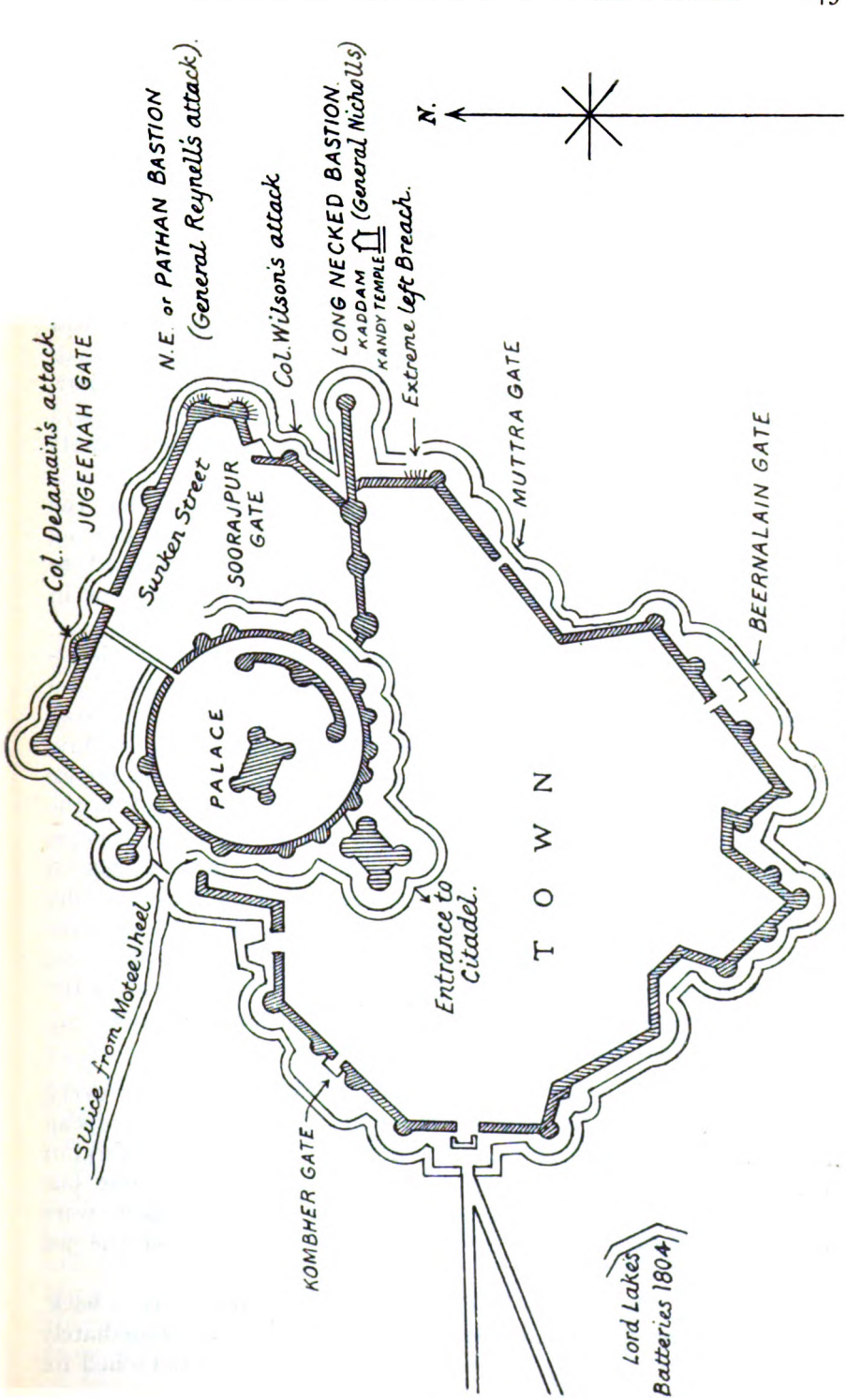

SKETCH OF BHURTPORE.—SECOND SIEGE.

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DEFENCE OF KHELAT-I-GHILZAI, 1841-42.

Khelat-i-Ghilzai is a small fort built on a high flat-topped hill, rising abruptly from the plain, about 150 ft. above its level—situated 87 miles from Kandahar, 134 from Ghazni, and 229 from Kabul. From the centre of this table-land rises, to about a height of 100 ft., a small conical hill which formed the citadel.

The garrison consisted of 600 of the 3rd Regiment of Infantry, in the service of Shah Shujah; three companies of the 43rd Bengal N.I., under Capt. Webster and Lieut. Trotter; 40 European artillery, 23 Native Sappers & Miners; Major Leech, Bombay Engineers, Political Agent; Dr. Campbell Mackinnon; Lieut. H. Milne attached to Shah Shujah's force as Commissariat Officer and Lieut. T. Studdert, Bengal Engineers, Executive Engineers; Lieut. David Gaussen and Lieut. Robert McKean, about 950 in all—under Capt. John Halkett Craigie.

This noble little garrison maintained their position during the whole winter, from November, 1841, until relieved by Colonel Geo. Peter Wymer on the 26th May, 1842, although exposed to cold and privation unequalled by any of the victorious troops in Afghanistan.

On the 21st May, 1842, they repulsed in a most gallant and determined manner a fierce assault that was made on their position by a large body of Ghilzais, variously estimated by themselves from 5,500 to 7,000 men. Capt. Craigie in his despatch dated 21st May, 1842, says "that Khelat-i-Ghilzai was attacked at a quarter before four o'clock this morning in two places, viz. at the long neck to the north-east, and at an outwork constructed last winter by the Sepoys, to give a raking fire in rear of the barracks. The enemy advanced to the assault in the most determined manner, each column consisting of upwards of 2,000 men, provided with 30 scaling ladders, but after an hour's fighting were repulsed and driven down the hill, losing five standards (one of which was planted three times in one of the embrasures) and the whole of which are now in our possession.

* * * * *

"The greatest gallantry and coolness were displayed by every commissioned, non-commissioned officer, and private (both European and Native) engaged in meeting the attack of the enemy, several of whom were bayoneted on the top of the sandbags forming our parapets. On our side I am happy to say only six Sepoys were wounded, viz. two of the detachment 43rd N.I. and four of the 3rd Infantry.

"A body of about three hundred of the enemy were driven back, took shelter under the rocks below the outwork, but were immediately dislodged by a company of the 3rd Infantry, which I detached for that purpose."

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They left 104 dead bodies at the foot of the defences, and within a few days after the assault the Political Agent ascertained that the number of killed, and of wounded men who died immediately after the action, considerably exceeded four hundred.

Siege and Capture of Ghazni, 1839.

Ghazni is a walled town with a deep ditch, situated in a plain surrounded by high mountains, by a spur of one of which it is commanded. In the centre of the town is a hill about 300 ft. high, on which is the citadel. A small stream runs near and round the town, and there are numerous walled gardens occupied by the Afghans.

At the time of the first Afghan war in 1839, the fort was garrisoned by from 3,000 to 4,000 men under Hyder Khan, the son of Dost Mahomed, and the Ameer of Afghanistan had therefore calculated rightly upon the British force being delayed for some time before it. He and his emissaries had had no difficulty in deceiving MacNaghten as to its strength and the nature of the resistance likely to be offered, and so completely was the latter deceived by the information supplied, that the day before Ghazni was reached he declared the place to be empty. Acting on this information the Commander-in-Chief and his staff rode on ahead to enter the deserted fort and they were only undeceived when fired on and compelled to return. Two forces under the Ghazni chiefs, Abdul Ruhman and Gul Mahomed Khan, had meanwhile marched parallel to the British all the way from Khelat-i-Ghilzai, one on each flank, at a distance of from 12 to 15 miles, with the object, not of immediate attack, but of taking advantage of the anticipated check to our troops at Ghazni, and of any confusion that might result therefrom. It cannot be denied therefore that when our troops reached Ghazni and found it strongly guarded, their position was critical in the extreme. Not only was the food supply short, but the breaching guns also had been left behind and there was only one battery of 24-pounder howitzers with the force, and these were useless for battering purposes. In their dilemma, the Envoy and the Commander-in-Chief (Sir John Keane) called upon the Chief Engineer (Capt. G. Thomson, of the Bengal Engineers) to reconnoitre and report.

He did so, and placed two alternatives before Sir John Keane, viz. either to blow open a gate and immediately assault, an operation the success of which may be doubtful and generally attended with heavy loss, or to mask the fort by a small corps, and with the rest of the army advance and attack Dost Mahomed. The latter alternative was abandoned, as the army was without the necessary supplies, and the proposal to assault was approved. A party of engineers was told off to the desperate duty of blowing in the gate in connection with

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which the following extracts from the diary of Lieut. James Broadfoot are of interest :—" A bag of 300 lbs. of powder was to be laid at the Kabul Gate, protected by the fire of the batteries and by the Goorkhas. The gate was to be blown open, and a storming party, composed of four European regiments was to advance immediately. I volunteered to carry the bag, as did Pigou ; but the latter was refused. Later in the day William* came, very excited, and told me he was not to go, the corps having been stopped on the pretence that the Shah was not sufficiently protected. He nearly threw up his commission in the Shah's service, but at last went away to try to join his old corps as a volunteer. Batteries and embrasures were made and the guns put in position, and then daylight was awaited. At last Peat and the powder party appeared, when the eastern horizon was just strong enough to show the hills in strong relief. The garrison opened fire on them ; the covering party extended on the edge of the ditch replied ; a few minutes afterwards a large volume of smoke above the walls and a rushing sound showed that the explosion had taken place. The head of the storming party now appeared with Brigadier Sale, doubtful whether to proceed or not. In this emergency I offered to go on to see if the explosion had been effectual. Being allowed I ran on towards the gate ; my anxiety to get on, and the constant whirring of balls past my head, made every step appear a mile. A little farther on I got into the range of the camel battery, and had to creep along to avoid our own balls. At last I met Durand† and shouted " Has it failed ? " He called out, " No, no." I then ran back so fast that my breath was entirely taken away. Peat and Macleod were stretched under a little tomb half-way, the former groaning heavily. He had been rolled over and over by the explosion, and was much shattered.

My report having been made the advance was ordered. I then ran on to the head of the column and entered with it, exposing myself to a severe reprimand. From the advance of the powder party not a quarter of an hour had elapsed, yet it seemed an age. On our way to the gate a shower of matchlock balls was kept up from the fort, with an occasional round shot, while our own artillery was thundering in our rear. Once within the darkness of the archway the fire stopped, the men gathered close, and sent up a magnificent cheer, in which we all joined and thus was our first step gained. A rush was made at the gate—the vicinity of which was nearly deserted—and it was carried with small opposition.

The colours were then planted on the four corners of the palace. The firing in the town was as constant as ever, few people asking quarter, and

* Lieut. William Broadfoot, of the 1st European L.I., now the Roya. Munster Fusiliers. he was then attached to Shah Shujah's force.

† Afterwards Major-General Sir Henry Durand, K.C.S.I., C.B., Lieutenant-Governor of the Punjab.

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no one giving it." Lieut. Broadfoot describes how he saw men jumping from walls 30 ft. high, or sliding down ropes, or hunted through the streets by soldiers with their bayonets close to their backs. Outside, the cavalry killed about 100 or 200 men, and 1,700 prisoners were made.

The result of the capture was decisive; it was worth many lakhs of rupees paid by political officers to secure immunity from attack, or to induce treason in the enemy's camp. The Afghans learnt for the first time that the English could strike a heavy blow, and respected them accordingly. Dost Mahomed behaved under the circumstances with his accustomed bravery. He had brought his troops from Kabul to oppose the advancing force, and finding that his men were shaken by the news from Ghazni, he rode amongst them, Koran in hand, begging them to support him so that at least he might die with honour, after which they might if they pleased join Shah Shujah. It was in vain; his men deserted him, and with his family and a small remnant of his force he fled to Bamian.

Our army found the Amir's guns at Arghandeh, and, advancing by regular stages, occupied Kabul on August 7th, 1839, and seated Shah Shujah on his throne, without opposition on the one hand, but on the other, without the slightest popular enthusiasm.

It should be mentioned in connection with the capture of Ghazni that whilst serving as an Engineer officer through the first Afghan war it fell to the lot of Lieut. Durand to undertake the duty of blowing in the gate of the fortress, an operation rendered necessary by the absence of any siege train. In reference to this brilliant episode it may be remarked that in the obituary article which appeared in *The Times* newspaper on the occasion of Sir Henry Durand's tragic death, more importance was laid on his share in the work than it appears he really deserved. This called forth a remonstrance from Lord Keane, who wrote: "The credit of blowing in the gate was entirely due to Capt. Thomson,* the Chief Engineer. Lieut. Durand performed his part of firing the train with great coolness and self-possession, being fully exposed to the enemy's fire from the ramparts while he applied the match to the fuze, which he had some difficulty in lighting."

Lieut. James Broadfoot, in his notes on the siege, writes thus: "Whilst to Capt. Thomson is due the credit for planning the demolition of the gate of Ghazni and the immediate assault of the fortress, to Lieut. H. M. Durand must be assigned that of successfully carrying out the instructions. He exhibited there the greatest coolness and gallantry in the most dangerous situation. After the powder was laid and all ready, the port fire did not light as it should have done,

* The late Lieut.-Colonel George Thomson, Bengal Engineers.

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and he had to blow the slow match and port fire until at last it ignited. He then watched it burning for some time before returning to cover." The other engineer officers engaged in this arduous duty were, Capt. Peat, Bombay Engineers, and Lieut. (afterwards Lieut.-General) Macleod, Bengal Engineers. At Ghazni, indeed, it may be said that the army was indebted for its safety to its engineer officer, Capt. G. Thomson.

Sir John Keane—afterwards Lord Keane of Ghazni—did not fail to do justice to Thomson. He wrote: "To Capt. Thomson, of the Bengal Engineers, much of the success of this brilliant *coup de main* is due. A place of the same strength, and by such simple means as this highly talented and scientific officer recommended to be tried, has, perhaps never before been taken, and I feel I cannot do justice to Capt. Thomson's merits throughout."

Again in his General Orders, Sir John said: "The scientific and successful manner in which the Kabul Gate—of great strength—was blown up by Capt. Thomson, in which he reports having been most ably assisted by Capt. Peat, Bombay Engineers, and Lieuts. Durand and Macleod, of the Bengal Engineers, in the daring and dangerous enterprise of laying down powder in the face of the enemy, and the strong fire kept up on them, reflects the highest credit on their skill and cool courage, and His Excellency begs Capt. Thomson and officers named will accept his cordial thanks."

SIEGE OF MOOLTAN, 1848.

In April, 1848, two well-known, able, and popular officers—Mr. Vans Agnew, of the Civil Service and Lieut. Anderson of the 1st Bombay Fusiliers, had been sent with a large escort by the Lahore Government, to support an incoming Sikh Governor, Sirdar Khan Singh, and this at the request of the retiring Governor, Mulraj.

On the morning of the 18th April, the two officers were riding unarmed out of the fort when they were attacked by the soldiers of Mulraj, and both were severely wounded. They were carried to a strong Mahomedan building called the Eedgurh—a short distance from the city walls—in which they were lodged. Mulraj, who was present, rode away without offering any assistance. Next day the escort proved faithless and Mr. Vans Agnew and Lieut. Anderson were attacked by a furious and excited mob and brutally murdered.

Sir Henry Lawrence, who was the British Resident at the head of the "Lahore Durbar," was in England on sick leave at the time, and the absence of his determined leadership made itself felt disastrously.

The movable column at Lahore was not launched against Mooltan immediately, and instead of this, four columns of disaffected Sikhs, led not by men like Sir Henry Lawrence, but by Sirdars of doubtful

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loyalty—amongst whom Sher Singh was pre-eminent—were sent against a Sikh chief with whose cause the rank and file of the force were in ardent sympathy.

These Sikh columns, moreover, did not reach Mooltan till some eleven weeks after the murder of the two Englishmen, at which date the rebellion at Mooltan was beginning to take on the character of a religious and national war.

At this time Lieut. Herbert Edwardes was the Political Agent in charge of the Derajat. No sooner did this young officer—a disciple and friend of Sir Henry Lawrence—receive Vans Agnew's letter asking for help, than, without asking for orders from Lahore, he swept across the Indus at the head of wild Pathan levies, and with the aid of Colonel Van Cortlandt and the Nawab of Bahawalpur succeeded in driving Mulraj into Mooltan, which he thought he might succeed in capturing if speedily reinforced by "Napier* and some guns"; for both of which he begged in vain.

Forced into action by the energy of their subordinate, and by the danger of their position, the British authorities at last despatched a column under General Whish to co-operate with him and the Sirdars in attacking Mooltan. The force arrived at Mooltan after the middle of August.

The strong fortress of Mooltan could only be taken by breaching its walls and to do this large guns and heavy ammunition were needed. Carriage, however, was exceedingly difficult to obtain, while the boats and boatmen of the Ravi and the Sutlej were quite unfit to be entrusted with so precious a convoy. Major Robert Napier*—the Chief Engineer of the Force—remembered the pontoon boats at Ferozepore, and thought that they might be used for this purpose if put into suitable hands, although unwieldy and not designed to carry freight through difficult waters.

He sent for Lieut. Alexander Taylor,† and asked him if he would undertake to carry the heavy artillery and engineering stores more than 200 miles down the Sutlej in his bridge boats. The young engineer replied in a delighted affirmative.

On the 30th July the heavily-laden flotilla started for its long row from Ferozepore to Adamwahan, 40 miles from Mooltan. The Chief Engineer and Alex Taylor travelled with it. Neither Taylor nor the boatmen knew the river; the boats were cumbersome, and there were many difficulties and obstacles during the journey, owing to rapids, shallows, rocks, sand banks, storms, and floods.

The flotilla, however, safely reached its destination—Adamwahan, opposite Bahavalpore—in little more than a fortnight, arriving on the 15th August; its contents were disembarked by the Sappers &

* Afterwards Field Marshal Lord Napier of Magdala, G.C.B., G.C.S.I., R.E. (late Bengal).

† Afterwards General Sir Alexander Taylor, G.C.B., R.E. (late Bengal).

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Miners, who had marched thither from Loodianah at 48 hours' notice. Steep and firm banks were found, beside which the water was sufficiently deep to allow the boats to come alongside; and the precious cargo, of which nothing had been lost *en route*, was gradually unladen and heaped in gigantic piles on what seemed to be *terra firma*.

Without siege materials it would have been impossible to inaugurate a siege, and it was only owing to Taylor's energy in moving the stores further inland, that these were saved, as the whole area on which the ammunition had been heaped, owing to the water undermining its base, shortly after collapsed into the rushing stream.

Day by day more siege material arrived but so great was the amount required that it was not till the 4th September that the engineer and artillery parks received their full equipment.

Immediately after the arrival of the complete siege train, General Whish issued a proclamation inviting the inhabitants and garrison to surrender unconditionally, within 24 hours of the firing at sunrise on the 5th of a Royal salute in honour of Her Most Gracious Majesty the Queen of Great Britain, and her ally, His Highness the Maharajah Dhuleep Singh.

"On the morning of the 5th, accordingly," writes Taylor, "the force turned out, and the artillery fired a Royal salute from 24-pounders. Before the sixth round, we received Mulraj's reply—a 14-pound ball, said to contain Whish's proclamation! The direction was good, but it fell short and hurt no one. Mulraj had spoken; and preparations for the siege were at once commenced."

On the 6th September a Council of War was held, during which the general plan of the siege operations was fixed. The plan adopted after much discussion—two other projects having been negatived—was that a trench should be run from the north-easterly angle of Herbert Edwardes' camp to a point called Ram Terut, a mile further to the north-east, and that this trench should be used as a base from which to advance on the city.

The town of Mooltan lies in the midst of a desert. Its climate in summer is exceedingly hot. Though rain rarely falls, the city and its environments, which are exceedingly wealthy, are richly provided with artificial canals of running water.

Between the walled gardens, enclosing country houses, lie dirty villages, temples, tombs, mosques, brick kilns, ravines, and fragments of mere jungle; ground, easy to defend and most difficult to clear.

The suggested trench was a "first parallel"; it was destined to afford cover from which the troops might advance over the difficult ground lying between it and some position from which the town wall could be distinctly seen and breached.

The first step in the realization of this plan was made next day (7th September). At dawn, working parties, numbering in all 2,800

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men, left their camps and set themselves to trench work. The composition of General Whish's Army now gave rise to complications. It contained 20,000 men of all arms ; 13,000 of these were Irregulars, largely Herbert Edwardes' Pathans, men who would dig trenches for themselves, fight anywhere and against any odds, but would not put a spade into the ground for the defence of others ; against this their pride rebelled, it was contrary to " custom." The burden of the digging was therefore thrown on the Native Regulars and the British regiments. It was found, however, that the latter could not face the sun, it simply struck them down. These difficulties were met by two expedients ; the British troops were permitted to work at night, and the Pathans were allowed to carry out a separate set of parallels of their own ; " this separate attack was conducted by Lieut. Lake, assisted by Lieuts. Charles Pollard* and Frederick Maunsell†, two young Engineers, " whose cool bravery and indefatigable zeal won the admiration of us all," writes Herbert Edwardes ; who adds : " The same remark would, however, apply to the whole Engineer staff at Mooltan—a finer body of men was never collected in any Indian Army."‡

The rebels set themselves to work at the same time to entrench themselves in the vicinity of the city. " So," writes Herbert Edwardes, " there were two armies throwing up works within a few hundred yards ; the rebels with little science, but unbounded zeal, rearing stockades, piling up felled trees and the woodwork of wells and houses, for the defensive warfare in which the soldiers of the Punjab excel ; the British approaching with laborious discipline to the attack which, at the proper moment, would burst from the trenches like a flood, and sweep all obstacles away."

Presently the process of dislodging the enemy from the aforesaid defences, houses, gardens, etc., began. The house-to-house and hand-to-hand fighting that ensued was of a most desperate and determined character.

We read of the cool courage with which the officers of the engineers placed scaling ladders and laid explosive bags close under the fire of the enemy's muskets ; of the rush of the soldiers surging over garden walls, or leaping from these walls on to trees, from the boughs of which they dropped into the midst of the enemy ; of confused attacks on unknown ground ; of hundreds of Mulraj's soldiers being heaped beneath the mango trees in walled enclosures ; and of our own many heroic dead. Ever to the fore in the midst of these brave assailants was Robert Napier, chivalrous, cool, and fertile in resource.

Sometimes driven back, often brought to a temporary standstill.

* The late General Charles Pollard, R.E. (late Bengal).

† General Sir Frederick Maunsell, R.E., K.C.B. (late Bengal).

‡ *A Year on the Punjab Frontier*, by Major Herbert B. Edwardes, C.B. 2 vols. Richard Bentley, London, 1851. 2nd edition, ii., p. 513.

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the invading tide of British soldiers nevertheless pressed steadily on, taking point after point of vantage, until on the 13th of September, the engineers stood on the destined breaching ground—the summit of a cone in one of the suburbs, which rose within 600 yards of the Bloody Bastion, and from which the masonry of that tower could be seen for at least two-thirds of its height. Without loss of time, and protected by seven batteries already erected in its rear, the Sappers & Miners set to work on the great Breaching Battery.

All was going well. The day of the assault seemed to be within measurable distance, when on the morning of the 14th September came the news that Sher Singh—the chief of our allies, the Lahore Sirdars —had gone over to the enemy during the previous night taking the column of 4,300 Sikhs with him.

The transference of so great a weight from one arm of the scales to the other so altered the relative strength of the two armies that General Whish was obliged to suspend operations. The projected attack was abandoned for the time being ; our hardly-won positions within breaching distance of the walls ; the streets, houses, and fortified posts, just taken ; our own batteries and trenches—all were deserted ; and the British Army fell back in the direction of Bahawalpore, whence it drew its supplies, there to await reinforcements which were immediately ordered from Bombay.

There is no doubt that this step was necessary. Major Napier, who was among the wounded, gave it as his professional opinion that the force at General Whish's disposal after the desertion of Sher Singh was insufficient for the successful execution of his plans, and in this opinion he was supported by the most experienced officers in the camp.

The first act in this retrograde movement was the withdrawal of the guns, ammunition, etc., from the Great Breaching Battery and its neighbourhood. This was done at nightfall on the 14th, under cover of the falling darkness, and without molestation from the enemy. By some oversight no orders had been issued to the engineers for the removal of their large depôt of tools and engineering materials.

The loss of these stores would seriously affect the park equipment, and Taylor resolved to recover them if possible. Taking a sufficient number of camels and workmen, and a few of the Park Guard, he sallied out into the darkness, and made his way towards the city. On arriving at a reasonable distance from the Breaching Battery, he halted his escort and rode on alone. On reaching its neighbourhood he was pleased to find that it was still the target for the enemy's fire, for this showed that the British withdrawal had been unobserved, and that it was still believed to be in our possession. He went up to it, and found it unoccupied. He signalled to his men to advance to the Engineer depôt, and the tools were soon in the hands of their lawful guardians. The camels were

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quickly laden and their heads turned homewards, and the party eventually reached the engineers' camp safely, not without adventures, but without serious molestation. The rescue was accomplished only just in time; next morning the whole of the area abandoned was in the hands of the Sikhs.

To prevent Mulraj's rebellion from growing into a Sikh war, by entrusting the Sikh Durbar with the task of quelling it, had been the political object of the Siege of Mooltan. This object was defeated by the defection of the Sikh Sirdar, Sher Singh, after whose desertion it was clear that a second Sikh struggle for national independence was inevitable. It was further clear, that the struggle would not take place at Mooltan, but in the home proper of the Sikhs, the country north of the Munjha, lying between the Chenab and the Jhelum, where fighting on an imposing scale might be expected.

These circumstances made the Siege of Mooltan, *per se*, a matter of secondary importance; it was all-important, however, that the heavy artillery collected there should be set free soon, for it would be urgently needed in the north. It was because all the available troops in Northern India would be wanted by the Commander-in-Chief to meet the new emergency, that the reinforcements necessary to the renewal of the siege were ordered from the south, *i.e.*, from Bombay.

In the meantime General Whish's Army temporarily abandoned its position. On the 15th September the forces of the Nawab of Bahawalpur, those of Van Cortlandt, and the Irregulars commanded by Herbert Edwardes, fell back to their new camp in and near the village of Suraj Kund, some 5 miles south of Mooltan. A few days later the British troops took up a position on their left. "Our camp," says Alex Taylor, writing from it on the 14th November, "was pitched in the midst of high jungle or underwood, some 8 ft. in height, but by dint of hard labour the ground to our front had been cleared to a distance of about 600 yards, and we are now in a tolerably good fighting position."

The removal from one camp to another of the great quantity of siege material collected was a large undertaking. Innumerable country-carts, gathered together for the purpose, plied backwards and forwards between the two camps, under the protection of 2,000 Irregular Horse and six guns, commanded by Lieut. Richard Pollock,* who defended the convoy from the flanking attacks of Sher Singh's Sikh horsemen. In spite of all efforts, however, sufficient carriage to move so much heavy ammunition was not forthcoming. Edwardes' Irregulars saved the situation. Each of his 1,500 horsemen took a cannon-ball—a 16-pounder—into his keeping,

* The late Major-General Sir Richard Pollock, K.C.S.I.

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and either holding it in his hand, or slinging it across his saddle, carried it to the new depôt.

The siege was raised on the 14th September, and not renewed till the 21st December. This long period of inaction—more than three months—was one of great anxiety. Opposite General Whish's small heterogeneous army rose the battlements of the city of Mooltan, which was overlooked by one of the strongest citadels in Northern India, manned by 15,000 men who fought with halters round their necks; while for some time Sher Singh, who never came to terms with Mulraj, or was allowed by him to enter the city, lay with his fanatical soldiery to the north-east. It was with feelings of intense relief that the British Army saw this storm cloud move northward, for, had those traitors, Mulraj and Sher Singh, been loyal to each other, and had they attacked the British camp simultaneously, things must have gone hardly with it. It was known at the time that Mulraj was intriguing with Dost Mohamed and others of our Trans-Indus foes, to whom he promised Peshawur and the lands west of the Indus, if they would invade the Derajat, and thus force the British Army to move away from Mooltan.

During this interval the engineers under Major Napier prepared busily for the future resumption of siege operations. A store of gabions and fascines on an immense scale was made; in December the Engineer Park of which Taylor had charge possessed the enormous number of 15,000 gabions and 12,000 fascines, as well as a number of ingenious mechanical contrivances for facilitating the siege operations, and invented by the Director.

On the 30th November Colonel Cheape,* the Chief Engineer of the Punjab Army, arrived, and took over the general direction of the siege operations. Detachments of the troops from Bombay were now beginning to arrive at Mooltan, and by the 21st December, the numbers of the besieging army were complete.

On the 27th, the British Army, moving *en masse*, retook the suburbs they had abandoned at the end of the first siege, and entrenched their position north-eastward as far as Mulraj's garden palace, Am Khas, 500 yards from the north-eastern angle of the fort. The rebels were driven in at the Delhi Gate, and positions seized on heights suitable for battering the south-eastern walls and the Bloody Bastion; the breaching battery destined to deal with the latter being only 120 yards from it. As these batteries were completed they began to pour their shot and shell against the walls which they were designed to breach.

On the 30th the Grand Mosque within the citadel—the rebels' chief powder magazine, and hitherto believed to be *bombproof*—was

* Afterwards General Sir John Cheape, G.C.B., Colonel Commandant, R.E. (Bengal).

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pierced by a shell and blown up. The explosion was terrific; an immense volume of smoke and débris rose in the air, and overspread the sky. "At a vast height," writes Herbert Edwardes,* "the heavy cloud stood still, like some great tree, and its shadow fell at night over the camp below. All action was suspended, every eye was turned up in awe, and watched the strange vision sink and disappear."

Finally, on 2nd January, 1849, the breaches having been declared practicable, a successful assault was delivered, and the city fell into British hands. Not the citadel, however, into which Mulraj withdrew with 4,000 picked men, leaving the rest of his army outside to die or escape as fate might decree.

Two breaches had been made in the south-easterly portion of the battered city wall:—one in the Bloody Bastion, and the other near the Delhi Gateway. The column destined to assault the latter was led by Robert Napier; while the perilous honour of guiding the Bombay Column up to the breach in the Bloody Bastion and through it fell, at the Chief's request, to Alexander Taylor.

The latter breach was carried by the 1st Bombay Fusiliers, Lieut. Anderson's regiment, to whom the place of honour in the avenging column was given as a right. Sergt. John Bennet, of the same regiment, planted the regimental colour on the crest of the breach, and stood beside it until it was torn and tattered by bullets. The place was found to contain another trench inside, but this was also taken after a bloody struggle.

"Then, from every crowded height and battery whence the excited struggle had been watched, rose the shouts of applauding comrades, and through the deafening roar of the musketry which pealed along the ramparts and marked the hard-earned progress of the victorious columns through the streets, both friend and foe might distinctly hear that sound, never to be forgotten—the 'Hurrah' of a British army after battle"; so writes one who was present. By nightfall the army was in entire possession of the city.

The following additional account of the Siege of Mooltan, with some details of the construction of the trenches and batteries, is taken from the Biographical Notice of General Sir John Cheape, G.C.B., who was the Chief Engineer of the Army:—

"The city of Mooltan is situated 4 miles from the present left bank of the Chenab, enclosed on three sides by a wall from 10 to 20 ft. in height, but open towards the south, where the dry bed of the old Ravee intervenes between the town and the citadel.

The original town consisted of two islands which are now crowned by the citadel and city, at an elevation of about 50 ft. above the surrounding country. The fortifications were dismantled in 1854,

* Major-General Sir Herbert Edwardes, K.C.S.I.

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but the fort still remains a place of considerable strength, occupied by a European garrison. Within the city proper, narrow and tortuous streets, often ending in *culs de sac*, fill almost the whole space; but one broad bazár—constructed by the British immediately after the annexation—runs from end to end. Mooltan is a place of great antiquity. The principal buildings include the shrines of the Mohammedan saints Baha-oo-din, Ruku-ul-alam, lineal descendants of the Prophet, which stand in the citadel. Close by are the remains of an ancient Hindu temple called Paládpuri, blown down by the explosion of the powder magazine during the siege of 1849.

On Christmas Day General Whish had occupied his old position, and the Bombay force under the command of Brigadier the Hon. H. Dundas next day formed on his left.

On the 27th the enemy in the suburbs were attacked by four columns. Brigadier Dundas commanding the left, moved round the left of the first original parallel, and drove the enemy successfully from the Maya Temple, and the mound called the Sidi Lal ke Bed, and the Baghi Bagh. Brigadier Casson advanced against Ram Tirat and compelled the enemy to evacuate the Mandi Awa and drove them out of the suburbs into the city.

The right column occupied without any loss the suburbs and buildings east and north-east of the citadel, and the brick kilns with their entrenchments.

General Whish had decided on attacking the north-east angle of the citadel in regular form, but Brigadier Cheape advocated an attack upon the suburbs and town. This was considered too great a risk, but a diversion on the south-east side was resolved upon. There was therefore a right and a left attack; the first fell to the Bengal gunners, the latter was shared with the Bombay artillerymen. The numbering of the batteries was that of the engineers, which included both Bengal and Bombay batteries.

December 28th. Right Attack.—A ravine to the right of Shams-i-Tabiz occupied the day before was converted into a battery, No. XI., for six 8-in. mortars, which moved out of park that evening and opened this morning at 700 yards from the outer wall of the fort. The infantry posts were loopholed. At dusk No. X. for two 24-pounders to destroy the upper defences of the north-east face of the citadel, and No. XII. for two 8 and three 10-in. howitzers to enfilade the face commanding the town, were marked out.

Left Attack.—No. I., three 10 and four 5½-in. mortars (Bengal) were established during the night on the Mandi Awa. No. II. for six 18-pounders to breach the curtain near the Khuni Burj at about 120 yards, was traced out, but not completed, material having to be conveyed from a distance. In the morning a heavy matchlock fire prevented more than the revetting of the finished portion. No. I. opened in the evening and continued during the night.

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December 29th. Right Attack.—Nos. X. and XII. commenced and completed during the night as also connecting trenches with Shams-i-Tabiz. They were armed and opened during the day and trenches widened.

Left Attack.—On the previous day Edwardes and Lake had relieved the Bombay troops of the posts about Sidi Lal ke Bed, and the latter closing to the right had their left posts in the suburbs about the Khuni Bhurj. No. II. was completed by midnight, but the first gun was not brought in until daybreak, and a company of the 9th Bombay Native Infantry was unable, after several attempts, to bring in a second. Several gunners were wounded.

December 30th. Right Attack.—Magazine for No. XII. was commenced and completed.

Left Attack.—No. II., completed during the night and opened at daybreak. No. V., for two 6-pounders, was commenced and armed by daybreak among the houses near the Delhi Gate, to destroy the town wall defences at about 200 yards. Two Bombay 18-pounders and two 8-in. howitzers were placed behind a mud wall opposite the Delhi Gate, and opened with effect upon the gateway. The mud wall coming down, a sandbag battery was put up.

At 10 a.m., this day a shell from a mortar laid by Lieut. Newall in No. XI. Battery fell upon the principal magazine near the southern face of the fort, a mosque which had been appropriated for that purpose, and which blew up, opening an extensive crater in the ground through the inner wall. General Whish in his report compares it to the explosion at the Siege of Hattras, March 1st, 1817. When the smoke and dust had cleared away the enemy resolutely resumed their fire.

January 1st, 1849.—On this day the Commanding Engineer at noon reported the Khuni Bhurj as looking well, though not likely to be a good breach, and recommended the assault, if it were to be made here, to be done at once.

Right Attack.—No. IX. completed. Repairs to batteries during the day.

Left Attack.—The fire of the four right* guns of No. II. was turned from the curtain on to the Bhurj itself. No. VIII. Battery armed and opened fire. Capt. Siddons examined the breach in the early morning, and reported it practicable though steep. That at the Delhi Gate was said to be sufficiently practicable for an attempt.

The troops told off for the assault left camp after noon in two columns ; the right under Brigadier Markham, to attack the Delhi Gate ; the left under Brigadier Stalker, to attack the Khuni Bhurj.

The Bombay column was completely successful, the leading party

* This was done by Lieut. (afterwards Lieut.-General) Pollard, Bengal Engineers, without interfering with the direct fire of the left pieces.

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crowning the breach found the communication with the Bhurj interrupted, but with the aid of two ladders procured by Lieut. Oliphant* and his sappers, they got over a low house into it, driving out the enemy.

The other parties forced their way through the town, taking possession of the Pak, Haram, and Bohar Gates, which were held during the night. Major Scott was wounded. That under Markham, on getting to the Delhi Gate, found the lower part of the wall, previously concealed from view too high for escalade. Capt. Smyth, with great decision withdrew the leading companies under cover. This column had to find its way in through the other breach, whence it followed the eastern face of the town to the Delhi Gate. The Daulat Gate was taken next morning. Major Napier (afterwards Lord Napier of Magdala) commanded the engineers here. Capt. Garforth was dangerously, Lieuts. A. Taylor and J. A. Fuller severely, wounded; the latter by an explosion of a magazine near the Bohar Gate."

Thus fell the town and citadel of Mooltan, after a resolute defence and severe fighting. The Mulraj was put on his trial for the murder of an official, and being found guilty was sentenced to death; but this penalty was afterwards commuted for that of transportation. The district at once passed under British rule.

* Afterwards Major-General Oliphant, R.E.; died in 1898.

(*To be continued*).

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MEMOIR.

LIEUT.-GENERAL H. A. BROWNLOW, ROYAL ENGINEERS.

It is not always easy to write a memorial of a very dear friend. One does not wish to write extravagantly on the one hand, nor to omit points of importance on the other. I think then that I had better state at once that in all my long life I never knew a better man than Henry Brownlow.

He was born on the 1st March, 1831, and came of good Ulster blood. He used to spend his holidays in the North of Ireland. His father belonged to the Bengal Civil Service, and in due time his son obtained what used to be called "a cadetship" in the East India Company's service, and went through the Military College at Addiscombe. On the 11th December, 1849, he obtained his commission in the Bengal Engineers, and after some time spent at Chatham he went to India, and was posted to the Irrigation Department in the N.W. Provinces.

At that time the department was on a very small scale, its officers being nearly all Bengal Engineers. They had however as their chief a man of real genius, Sir Proby Cautley, an Artillery officer, absolutely without any engineer training, but a born engineer. Under this officer young Brownlow began his career. There is no great work that bears his name, but of strong common sense, high courage and untiring energy he made his mark wherever he went. He was an excellent rider even after he had partially lost the use of his leg.

In 1856 Brownlow was Executive Engineer of the Eastern Jumna Canal, a small but a very important work, watering an area of some 500,000 acres, extending from the foot of the hills to opposite Delhi, a distance of about 130 miles. He might have spent all the rest of his service on those irrigation canals, when to him, as to so many others, came the great Indian Mutiny. From Benares to near Umballa the whole country was in a blaze of excitement and revolt, and the few scattered English residents flocked into the nearest garrisons.

The headquarters of the Eastern Jumna Canal was at Saharunpur, a native town of some importance about a hundred miles up the canal from Delhi. The white population consisted of a judge, a magistrate, two assistant magistrates, and two or three irrigation officers; but these last from the nature of their duties were constantly moving about amongst the villages. There was besides a detach-

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ment of Sepoys on guard over the treasury where there was some revenue at the time. Brownlow was the only sportsman among them, and he had two fowling pieces. There were not more than two other guns among them all. Besides this small garrison there were two warrant officers with their wives and families, encamped on the canal, two or three marches from Delhi.

The chief source of danger lay in the detachment of Sepoys. Regiments were breaking out into mutiny all over India. Would anyone vouch for the fidelity of the company at Saharunpur. Whenever the news of the general outbreak reached Saharunpur, the judge called a meeting to decide what should be done. The ladies and children could easily be taken to a hill station not very far off. But how about the families of the warrant officers? They were in hiding during the days, and going from village to village during the nights. How could they be brought in?

The council of war at Saharunpur resolved that with their small numbers they could not spare a man to bring the families in. Brownlow said "Then I will go out alone." Then said his comrades "You must also take the Sepoys with you. We are unarmed, and must be protected from our protectors." The matter was thus compromised.

Brownlow had borrowed an elephant and two or three carriages. He started down the Delhi road. His Sepoys all went in front. He brought up the rear on his elephant with two loaded guns across his knees, and never taking his eyes off his Sepoys. About 15 miles from Saharunpur he met the two families he had gone out to rescue. The doubtful Sepoys dispersed of their own accord.

The Army was then on its march from Amballa to Kurnal and Delhi, along the Grand Trunk Road, which was blocked with endless carts and wagons, elephants, horses, camels, guns and camp followers, all the stores necessary for the prosecution of a great siege. Brownlow was called on to bring in stores from the left bank of the Jumna. The road was unmetalled. The Jumna was unbridged. It was the hottest season of the year. Brownlow had always been a delicate man, very subject to fever. The distance was about 90 miles. In spite of all these drawbacks he brought his convoy safely to Delhi. For the remainder of the siege he had charge of the Engineer Park.

Colonel Baird Smith who commanded the Engineers has thus reported :—"With what assiduous care and untiring energy Brownlow supervised these operations is known to all who served at the siege. Thousands of fascines, gabions, and other siege materials were collected, and the troops were also instructed by Brownlow in their uses and the method of packing them on camels. The arrival of the siege train having placed the Artillery in an equally satisfactory condition, ground was broken on the night of the 7th September."

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I have no intention of entering into the details of this famous siege. It has been described in many books, of which I would only mention two, both of them by ladies. Mrs. Flora Steel's *On the Face of the Waters*, and Miss Taylor's admirable biography of her noble father, General Sir A. Taylor, to whom more than to any other person was due the success of the enterprise.

On the night of the assault, while bringing up stores to the Kashmir Gate, Brownlow was dangerously wounded, and there was an end of campaigning for him. He was carried up to the hill station of Mussooree, and it was only after some months that he was able to return to duty at Saharunpur. It was during his stay at Mussooree that he made the acquaintance of Miss Ellen Eliza Brind, the daughter of General Sir James Brind, who shortly after became his wife. She has survived her husband.

In his tent one day the news reached him of a terrible gunpowder explosion at Lucknow. More than twenty lost their lives, and among them Brownlow's younger brother Elliot. They were both Sappers, and when Elliot lost his life he was on the eve of returning to the survey of Kashmir, Lucknow having been taken. When I first arrived in India in June, 1858, everyone was full of the praises of Elliot Brownlow, and he was thought quite equal to his brother Henry. They were heroes both. When Henry received the news of his brother's death he shut himself up in his tent for three days. When he came out he had changed. He had the old pluck and high courage, the same cheery good spirits; the same kindly ways which endeared him to all with whom he came in contact. But besides all this he was now the devoted servant of Jesus Christ. When he was fit for duty Brownlow returned to his work on the Eastern Jumna Canal.

One day he was out shooting accompanied by his assistant, the late Oliver St. John, and another young officer, when some villagers came and asked him to drive away a tiger which had got between them and their drinking water. They had only shot guns, and no bullets. But a mould soon enabled them to cast bullets, and they started on foot through the jungle. They fired, the tiger charged and knocked Brownlow over. I remember his telling me afterwards how fetid was the brute's breath as it lay on the top of him. Fortunately a bullet had gone through the tiger's jaw or it would certainly have killed him. As it was it crunched his left leg and his right hand. St. John killed the tiger, and for many weeks Brownlow was in a critical state, and was sent home on furlough as soon as he was fit for the journey. He used to say jokingly how much he owed to that tiger. But for it he would not have been sent home, and would inevitably have died of fever among the Saharunpur swamps.

During his absence on furlough things did not go very well with

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the Irrigation Department of the N.W. Provinces. There was no one in charge of the great Ganges Canal who had really had experience of such a work. The banks and bed of the canal had become greatly eroded, with a mean velocity exceeding $3\frac{1}{2}$ ft. per second. Great holes were scoured out in the bed and there was a fear that the bridges would become unsafe.

A committee of engineers was assembled at Roorkee, and they reported that unless the scour of the bed could be stopped the canal was in a very perilous state. It should therefore be widened, that weirs should be interpolated between the existing ones, and that a fourth arch of 50 ft. span should be added to each of the bridges. To carry out all this remodelling would require at least two years, during which the canal must be closed. A doctor who begins his cure by killing his patient is not likely to rise in his profession. Had the Ganges Canal been closed for two years the irrigation would necessarily have ceased, and thousands of peasants would have been ruined. Things looked very bad.

In 1868 Brownlow returned to India and inspired irrigation officers with fresh hopes. He showed them what a splendid work the Ganges Canal really was—that there was no need of a long closure if ordinary precautions were taken. He put the whole canal on to a sound footing, and so it has remained ever since. I have no idea of how many lakhs of rupees Brownlow at that time saved to the Indian Government, nor what is now the annual revenue of the Ganges Canal.

Brownlow was twice mentioned in despatches, and received a Brevet Majority for his services in the Mutiny. He eventually became Inspector-General of Irrigation, and Deputy Secretary to the Government of India. He also received a good service pension on his retirement in 1886. Some of us who had served under him were vexed that he did not receive any higher reward for his distinguished services. I am sure that in his great modesty he himself felt no disappointment on the subject.

After his retirement Brownlow settled with his wife and family first at Norwood and afterwards at Wimbledon. Henceforth all his energies were devoted to active charitable and religious work. He was on the committee of the Church Missionary Society, and gave many addresses which were said to be always clear, carefully worked out and inspiring. His addresses were specially appreciated by young men. He was a speaker of very high order.

For the last ten years of his life he was a great invalid, and was obliged to give up much active work. This must have been galling to a nature so vigorous as his; but he bore it all with cheerful patience, and used to say to his friends he was just waiting. He passed away early on the morning of the 19th April, surrounded by those he loved best.

COLIN C. SCOTT-MONCRIEFF.

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TRANSCRIPTS.

THE SIEGE OF ADRIANOPLE.

From an article by V. N. Polyanski in the September, 1913, and subsequent numbers of *Injenerni Jurnal.*

(*Concluded*).

CHAPTER V.

Conclusion.

The following points stand out prominently in the fighting which resulted in the capture of Adrianople :—(i.) That against prominent objects, like the permanent works of the East Front, modern artillery can not only support an infantry attack but also practically effect the capture of the enemy's position, by demolishing the works and driving away any who may survive of the defenders ; (ii.) that against unseen targets, like the majority of the batteries on the South Sector, and against " invulnerable " trenches, like those on Pamuk-Sirti or in the intervals on the East Front, the fire even of heavy artillery can do little harm, provided that these works are protected by shrapnel-proof head cover ; (iii.) that the rifle and machine-gun fire of very small numbers is sufficient to stop a powerful infantry attack, and (iv.) that the most modern weapons, like the artillery of the defence, are ineffective in the hands of untrained men and without skilful direction.

The weakness of the defences of Adrianople lay in the fact that the lines of trenches, wherein in this case rested the whole power of the defence, were not supported by serviceable strong points. In the *main defensive lines* the old, out-of-date, forts, and even the incomplete new lunettes, were not only useless for this purpose—as they could not even defend themselves, and much less the intervals between them—but positively harmful, as they occupied the more important tactical localities, and were consequently points of weakness most dangerously situated. In the *advanced positions*, the Turks, under the guidance of their German instructors, had rightly discarded old-fashioned redoubts, but had put nothing in their place, and the absence of strong points was a serious source of weakness to these lines, which were otherwise strong, owing to the correct siting and construction of the trenches, many of which were without parapets.

It is interesting to note that psychological reasons account to some extent for the obstinacy with which the advanced positions on the south and west were defended in comparison with those on the East Front. In the two former cases these positions were practically the main lines of defence, for in the south the artillery was posted in front

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of the fort line, and on the west there was no fort line. On the East Front the loss of the advanced positions would not have been necessarily fatal to the defence, and this may to some extent account for the feeble resistance which they offered to the assault.

In considering the form which the pivots or strong points of permanent fortifications should take in the future, it must be recognized that however skilfully the defence works are constructed with a view to concealment, the fact that the strong point must occupy some locality of special tactical importance will effectually disclose its position, and the concealment of its works, though it may usefully add difficulty to the ranging of the hostile artillery, cannot effect more than this. The strong point must expect to draw upon itself the extraordinarily accurate fire of modern howitzers, even of very large calibres, and what this may be was shown by the two-days' firing of the Servian howitzers on the South Front.

The tendency to replace forts by groups of two or three mutually supporting forts is very marked in modern permanent fortification. But even in this case the forts will not escape the accurate fire of the howitzers of the attack, and the fighting advantages of these fort groups can hardly be said to correspond with their great costliness.

The contest between solidity of construction and the penetration of modern shells cannot go on indefinitely, as there is a limit to the thickness of roofs, and no better material than concrete or ferro-concrete is to be found. To some extent the solidity of structures can be varied in accordance with their siting, and with their chances of being hit. But even if casemates were capable of resisting the blows of modern high-explosive shells, the condition of the works during a bombardment, the noxious gases, the flying splinters and the vibrations due to the explosions would probably render firing lines within them untenable.

It is evident that the all-important fire positions for the distant fighting cannot be in the strong points, and there are equally good reasons why they should be in the intervals between strong points, where their chances of escaping injury are far greater. They will consist of invisible and "invulnerable" fire trenches in combination with secure concrete shelters. The guns were the first to leave the strong points, and now the firing lines must follow suit.

We now come to the arrangements for flanking the intervals and the approaches to the strong points. There has been some inclination of late to underestimate the importance of these, in view of the power of the frontal fire of modern rifles and machine guns. But this is counteracted by the increasing use of the shovel in attack. Once the troops of the attack are entrenched in close proximity to the position they can be driven out only by enfilade or high-angle fire, or by a counter-attack. High-angle fire is difficult to make accurate at near distances, and in local counter-attacks against an entrenched enemy the advantages of the defence have passed over to the side of the attackers; enfilade fire upon the intervals and the approaches to the strong points must be organized as a means of opposing the "entrenching of the attack."

The means of obtaining this have hitherto been the "flanks" or flanking galleries, and the "interval caponiers" containing the guns

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allotted for this purpose, all of which have been included in the strong point. The " flanks " must still remain in the pivot, and if it is one of group character they may possibly take the form of " invulnerable " trenches located somewhere between the forts. But as such trenches cannot be considered as permanent works, the " interval caponiers " become all the more important ; and as the danger to them of fire within the strong point has become greater than the risk of capture outside, they also must be moved outside into the intervals. The guns must be mounted in disappearing turrets, and, to reduce as far as possible the danger of their fire to their own troops, they should be distributed to the number of three or four along each interval, the guns acting " for opposing assaults " in the sections in which they stand and " for opposing entrenching " in the adjoining sections.

What then remains of the strong point ? It remains a tactically important locality prepared for purely passive defence, its most important work being its obstacle, the ditch, with the frontal or flank defences in connection with it. All the means of active defence are moved out to places where they can the better fulfil their objects, and from whence they can bring fire upon the approaches to the strong point, and the most important fire of the strong point itself is that used in defence of its obstacle in the close fighting.

The strong point from its position will still be the lightning conductor which will attract upon itself the forces of the attack. It must be a permanent work, as no group of field character will suffice to defend its obstacle and the defences connected with it against the artillery and the operations of a regular siege.

For the artillery of the defence the experience of both Port Arthur and Adrianople shows that, if the guns are placed in concealed positions, permanent batteries, built of concrete, etc., are unnecessary for them. The batteries may be of purely field type, provided that shrapnel-proof head cover is provided for the gun crews. The covered-in batteries adopted by the Allies at Adrianople are suitable for this purpose. If the guns cannot be placed in concealed positions, armoured mountings appear to be expedient.

APPENDIX.

Details of the Fortification Works of the Servians in the North-West Sector of the Investment Line.

(From an article by V. Kotelnikov in the May, 1914, number of *Injenerni Jurnal*).

The following information regarding the work of the Servian Timok Division in fortifying their portion of the N.W. Sector of the line of investment was obtained from Lieut.-Colonel Stanoilovich, who commanded the Engineers of that division.

The works were begun on 8th December in compliance with an order issued the day before by the commander of the division, who was also in command of the N.W. Sector of the attack. A map of the works of the attack and the defence in this sector is attached (see *Plate* I).

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The following is an extract from the order :—

I. RIGHT FLANK SECTION (from the Maritza to the Kara-Bunar-Yekmekchi-Keui Farm Road).

(*a*). 1 Company 20th Regiment and ½ section Pioneers.	Redoubt No. 1 for one company with obstacles in front of the front faces. Tools :—160 shovels, 40 picks, 20 axes ; the pioneers to bring their own tools.
(*b*). 2 Companies 20th Regiment and 1 section Pioneers.	Group No. 2 of two redoubts, for one company each, and trench for one company ; obstacles on front and flanks. Tools :—320 shovels, 30 picks, 40 axes.
(*c*). 1 Company 20th Regiment and ½ Section Pioneers.	Group No. 3 of two redoubts, for one section each, and trench for two sections ; obstacles in front of the group. Tools :—160 shovels, 40 picks, 20 axes.
(*d*). 2 Companies 15th Regiment and 1 section Pioneers.	To make the group of Redoubts Nos. 4 and 5 with the trench connecting them ; (redoubts and trench for one company each). Tools :—320 shovels, 80 picks, 40 axes.

II. CENTRE SECTION (to Sarai-Ak-Bunar).

(*a*). 1 Company 15th Regiment and ½ Section Pioneers.	Redoubt No. 6 for one company. Obstacles. Tools :—160 shovels, 40 picks, 20 axes.
(*b*). 1 Battalion 13th Regiment and 1 section Pioneers.	The Tuashan-Kulaya group of works (consisting of Redoubts Nos. 7 and 8, for one company each, Lunettes Nos. 9 and 10, for one half-company each), and trench for two companies, in front of Sarai-Ak-Bunar. Tools :—640 shovels, 160 picks, 80 axes.

III. LEFT FLANK SECTION (from Sarai-Ak-Bunar to the Tunja).

. . . . . .

(This section was occupied by the 55th Bulgarian Infantry Regiment).

IV. REAR POSITIONS (consisting of Kemal Village and Redoubts Nos. 13, 14 and 15).

(*a*). 1 Company Infantry and 1 section Pioneers.	To put Kemal in a state of defence.
(*b*). 3 Companies 53rd Infantry Regiment* and 1 section Pioneers (Bulgarian troops).	To make Redoubts Nos. 13, 14 and 15 for one company each.

Profiles, where possible, to be the height of a man ; shelters to give protection from shrapnel ; overhead cover to loopholes to be provided, and also blindages ; obstacles to be wire entanglements and abattis ; cover for reserves to be sited approximately as shown in maps, well applied to the ground ; communication trenches also necessary.

The work of fortifying the position, including subsidiary works (loopholes, overhead cover, blindages, shelters, dug-outs, etc.) was pushed on energetically during almost the whole of the first period of the blockade. The conclusion of the armistice, which lasted from 3rd December, 1912, to 2nd February, 1913, enabled the Servians to entrench a second position closer to the Turkish lines, practically as if on manœuvres, without any interference from the enemy.

The most typical strong points are shown in *Plate* II. Redoubt No. 1 was in plan an ordinary closed work for one company, with wing trenches ; on the front and flank faces there were small traverses at intervals of from 15 to 20 paces, and in the gorge two blindages, for 10 men each, but which could, on emergency, and for a short period, hold a section ; the roofs of these blindages were calculated to be proof against direct hits of field artillery. The profile differs from the normal Russian type

* In reserve at Vizgach.

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in the complete absence of an outside ditch, which the Bulgarian engineers look upon as only a means of supplying earth for the parapet, if the latter is large enough to require it, as in Group No. 3; the obstacle to assault was some form of artificial obstacle, generally a wire entanglement, or more rarely abattis, placed 50 to 80 paces in front of the work.

From want of material the obstacles were placed before the front and flank faces only, and were at first only 14 ft. in width. This was done in the case of nearly all of the defences of the Allies before Adrianople. It infringed one of the essential rules of strong points, that which requires a "closed obstacle," but in this case no harm came of it, as the Turks directed their weak sorties against the intervals between strong points and against the artillery placed in rear of them, in the endeavour to do the greatest possible damage to the active forces of the attack.

In the profile of No. 1 Redoubt the low command of the parapet (1¾ ft.) and its glacis-shaped formation should be noticed, both features being important for concealment. Even with overhead cover to the loopholes the total height did not exceed 3½ ft. The low command of the firing line was possible owing to the smooth surface of the ground and the absence of vegetation in the winter months.

Group No. 2, consisting of two redoubts and a trench, each for one company, was designed for a battalion, the fourth company forming the local reserve. In rear of its centre, at 300 paces back, was a field battery of four guns, in a semi-concealed position. In rear of the flanks were shelters for the reserve, and a refuge casemate for the garrison.

Strong point No. 3 was another group, but in this case for one company only, with one section in each of the closed works on the flanks and the remaining two sections in the trench between them. The front faces of the redoubts had outside ditches of triangular section and these faces were also equipped with overhead cover, but of a worse design than that of No. 1 Redoubt.

In both No. 2 and No. 3 Groups the idea of the subdivision of units for defence is to be noticed; the case of No. 3 is especially interesting, where even the company was split up, and the two flank sections, at any rate, were taken completely out of the control of the company commander.

Of the remaining works those which showed the most original forms of construction were No. 6 *bis* (which was pushed somewhat forward from the line of investment) and that named "Kodgrobla" ("Tombs"), near tumulus + 90 m., on the position of closer investment (see *Plate* III.).

In both of these there was hardly any interior terreplein. The Servian Engineers had already shown a tendency towards this form of work, and under the Turkish shrapnel fire they became convinced that the depth of redoubts should be reduced to a minimum. In the works carried out during the armistice the results of this conviction are seen.

No. 6 *bis* had two small terrepleins on the flanks, but between them the front and gorge faces consisted, for the greater part of their extent, of a single combined trench. As this trench followed a crest line, equally good fields of fire were obtained from it to front and rear.

In the "Tombs" redoubt the trenches of the front and gorge faces were separated by a mass of earth of varying thickness, and the defenders of both faces were better protected from being shot in the back. *Plate* III. gives a copy of the design for this work. The large number of small traverses is noteworthy, but their siting is faulty, as they are drawn back in rear of the firing line and consequently give protection neither to the men lining the banquette nor to those on the step behind it. Each of the four blindages in this work could accommodate from 10 to 15 men. Their roof covering consisted of metal narrow-gauge sleepers, carrying 4·66 ft. of earth and two layers of stone rubble. Unfortunately there is no evidence to show whether this would have given protection against direct hits of fortress, or even of field, artillery, as no cases of such hits are reported.

Section II.—II. shows a form of overhead cover made of rails and sleepers of the narrow-gauge railway.

To recapitulate, the *strong points* on the line of investment were placed in the

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same line as the trenches; at intervals of 1,000 to 2,000 yards apart, thus possessing good fire command of the approaches to the intervals between them, and to their own front; they were extended in length and compressed in depth; they were usually made for garrisons of one company each; had all-round fire; but obstacles only in front; were generously equipped with small traverses and shrapnel-proof head cover; blindages, proof against direct hits of shells up to 3-in. calibre, were provided in them for the guards only; for the rest of the garrisons refuges of light construction were placed outside the works, at some 150 to 200 paces back, on reverse slopes.

With regard to the reduction, and even extinction, of the interior terrepleins of closed works, the supporters of this form of construction claim that its chief advantage lies in the reduction to a minimum of the area exposed to the action of hostile artillery fire. But they overlook the fact that losses depend not upon the size of the exposed area but upon the density of its occupation. When the gorge face is drawn nearer to the front face, its defenders, and also the interior reserve, are brought, without any special necessity, closer to the front crest line, which is probably the most visible part of the work and that on which the hostile artillery will direct their fire. The disadvantage of this will be seen when it is stated that even at 35 paces back the percentage of probable hits is only one-half that to be expected in the trench lying immediately in rear of the crest line.

Furthermore in a work like No. 6 *bis* there is only one line of communication between the flanks, while in one of normal design there are trenches of the front and gorge faces besides other interior lines. The "Tombs" work is but little better in this respect, as the distance apart of its two lines is less than the diameter of the crater formed by a field howitzer shell.

As regards the defenders of these faces, it is suggested that in works like No. 6 *bis* the defence from front and rear can be entrusted to the same men. But there is no reason why there should not be simultaneous attacks from front and rear, or at any rate demonstrations in combination with real attacks. Each face should have its own garrison, and where two such garrisons occupy the same trench it must lead to a certain amount of confusion.

This author calls particular attention to the abnormal conditions due to the two-months' armistice, of which one of the clauses sanctioned the continuance of the provision of cover for the outposts during its operation. This enabled the besiegers with impunity to advance their investment lines and to carry forward the transference of artillery and military stores at distances of less than 2,000 yards from the Turkish positions. The moral effect upon the defenders of the passage of the Bulgarian trains through the fortress, and of the intercommunication between besiegers and defenders, has been already mentioned.

The advantage to the defence of the *advanced positions* may be summarized as follows:—(i.) They kept the siege batteries at a distance; (ii.) they retained important observation points in the lands of the defence; (iii.) they, perhaps unintentionally, gave greater freedom of action to the defenders, by enabling them to get outside their line of obstacles; and (iv.) they increased the perimeter of defence to dimensions more in keeping with the numbers of the garrison.

As regards this last the Editor of the *Injenerni Jurnal* notes that with such an enormous garrison (58 battalions of infantry, with a fort line of 23 miles) advanced positions were not only useful but necessary, in order to make use of the superfluous numbers. But how would it be with advanced positions if the garrison was accurately estimated and only just sufficient for the occupation of the main positions?

F. E. G. SKEY.

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PLATE I.

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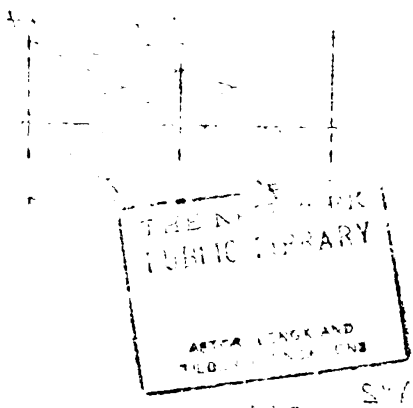

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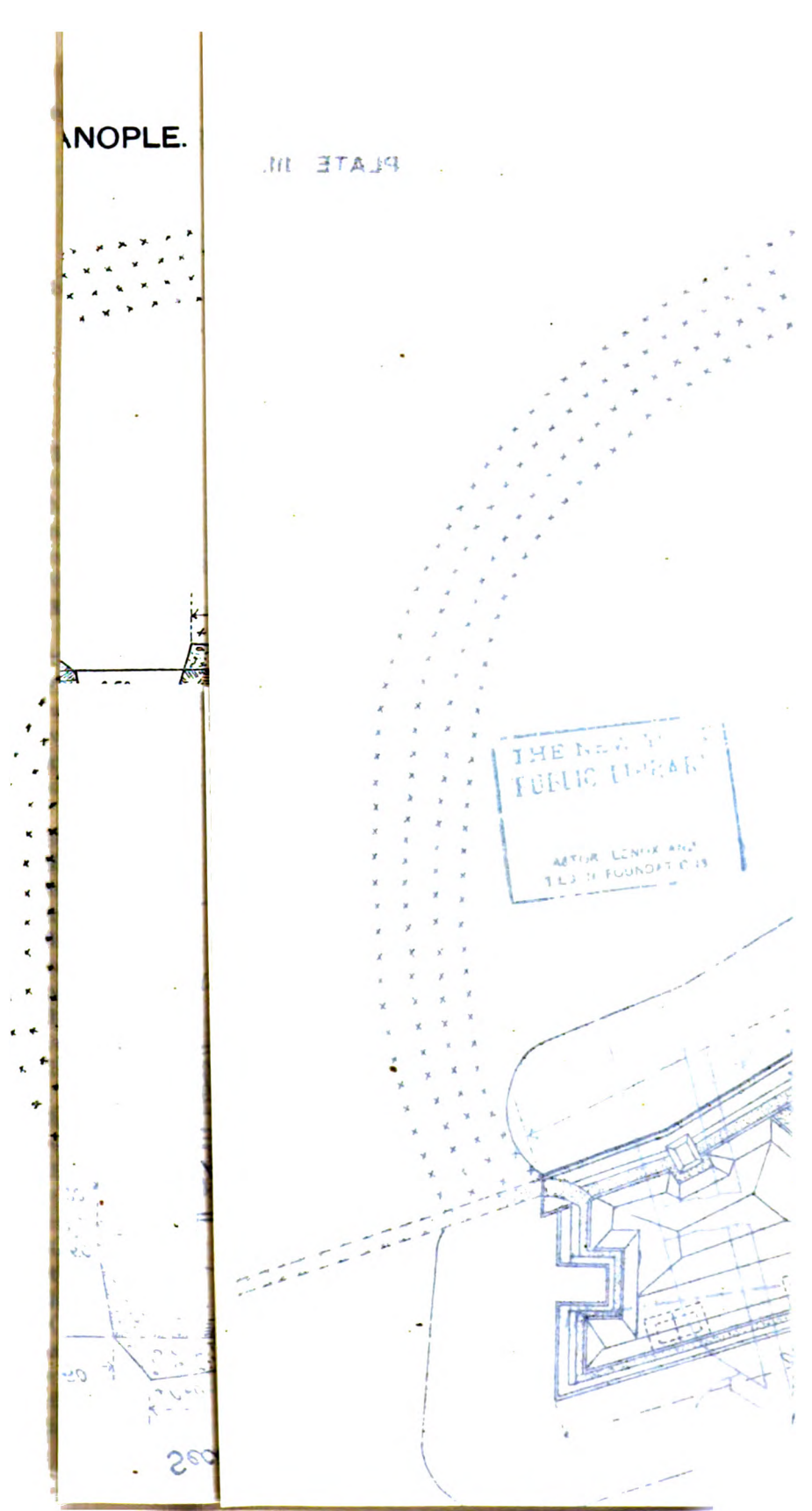

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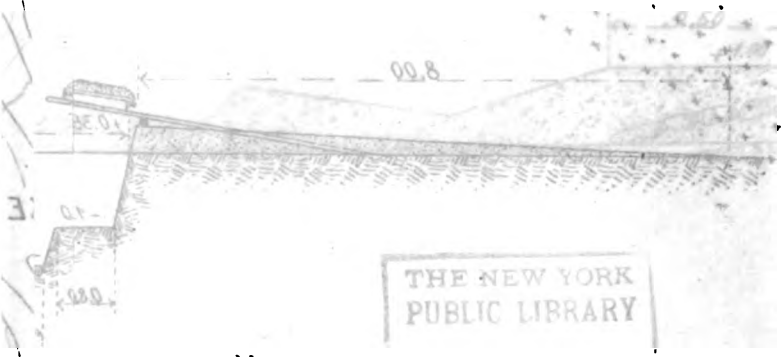

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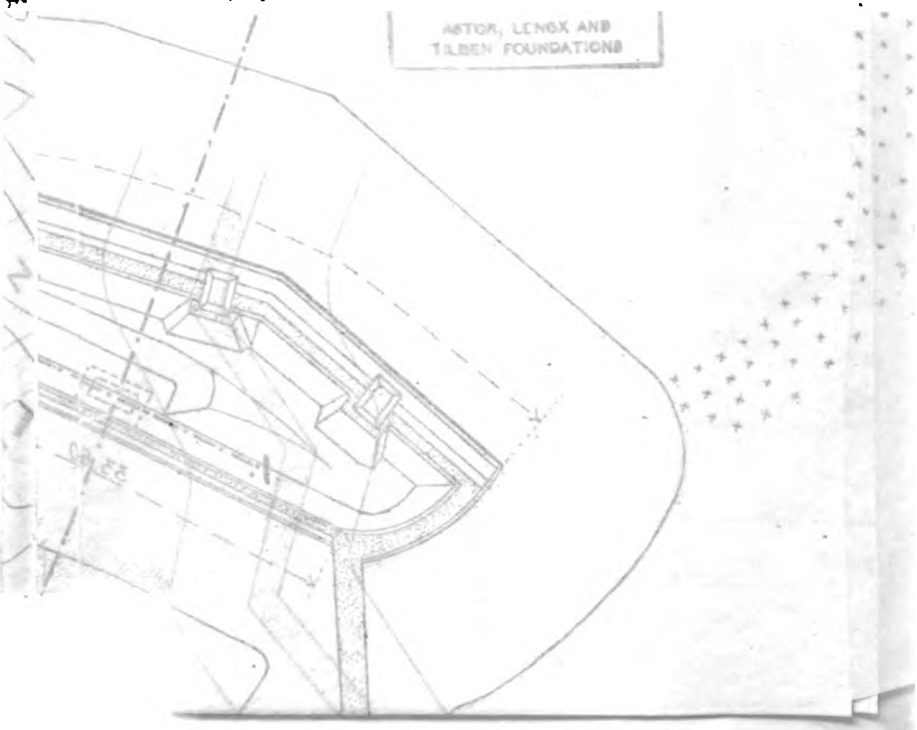

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HISTORY OF UNDERGROUND WARFARE.

Being a Review of the book by A. GENEZ, Captain of Engineers, French Army.—(Librarie Militaire Berger Levrault, Paris, Rue Des Beaux-Arts 5-7, 1914. Price 5 francs).

(*Continued*).

THIRD PERIOD.

The Siege of Candia demonstrated the importance of subterranean defence outside the fortress, and from 1670 all new fortresses had systems of countermines under the glacis, with listening galleries in masonry. Numerous systems were devised, but so far there was no rule for determining the weight of the charge with reference to the direction of its explosion, and to the weight and nature of the material to be moved. With Vauban a scientific spirit was introduced, and under his directions Mesgrigny undertook various experiments at the Siege of Tournai.

From these experiments it was wrongly deduced that however much the charge was increased the radius of rupture was always the same as that of a common mine, the only difference being that the materials were expelled with greater force. This error prevailed for half a century, when Belidor demonstrated the properties of overcharged mines; possibly the effects produced by large mines at Luxembourg and Turin suggested to him the need for further experiments.

At Luxembourg (1684) Vauban directed the siege works, assisted by several Engineers. The principal attack was directed against the Barlemont Bastion, which was itself protected by a counterguard, the escarp wall of which was 13 ft. thick at the base. Behind it was a masonry gallery 10 ft. high and 10 ft. wide. The whole was demolished by 22 charges of 440 lbs. each placed 4 ft. from the exterior face of the wall, and 15 charges of 385 lbs. each placed in the earth behind the inner wall of the gallery, which was 4 ft. thick. These charges must have been 12 ft. to 16 ft. below the top of the parapet, and 25 ft. to 30 ft. apart. The width of the breach opened was about 500 ft., the largest hitherto made by mines.

In 1706, during the Wars of the Spanish Succession, the French besieged Turin, which was held for the Duke of Savoy. The garrison was strong, the inhabitants were devoted to Savoy, and the fortifications had been improved by Vauban, to whom the King wished to entrust the conduct of the siege, but Mme. de Maintenon secured it for her son-in-law, the Duke de la Feuillade. Vauban would first have taken the Capucin Heights, on the east, or right bank, of the Po. They commanded the city, which was situated on the left bank. His scheme was sent to la Feuillade, but the latter preferred his own, which was to capture the Citadel on the West Front. He had attempted to do so once before, and the Duke of Savoy, forewarned, had recently constructed lunettes in front of the citadel with a countermined glacis in front, had divided the citadel into two parts by a retrenchment, and protected the bastions by counterguards.

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The French sent a fine army, with a numerous artillery, eight brigades of Engineers commanded by Tardif, and four strong companies of miners. From right to left the front attacked comprised the Amédée and St. Maurice Bastions of the citadel, with the demilune de Secours opposite the curtain between them covering the Secours Gate, then the Royal Bastion, the demilune of the Susine Gate, and a hornwork protected by a flèche, the last three being a part of the defences of the town itself. The countermines of the defence in front of the citadel were of masonry in two tiers, the upper tier being on a level with and entered from the ditch. There was also an improvised system, constructed since the siege had been threatened, in front of the other works mentioned. Every precaution was taken to organize a system of listeners, arrangements for firing mines, and materials for repairing damages.

On the twenty-fourth night of the siege the French commenced a gallery 50 yards from the Amédée Bastion. Progress was only 4 yards a day owing to the sandy ground and to damage caused by shells, and on 5th July a mine was fired, which did no damage to the countermines but formed a crater which was crowned. On 21st July another mine was fired 10 yards from the salient of the flèche in front of the bastion, the flèche was carried, and the powder hose leading to the defenders' countermines was cut. Next day the defenders fired a mine, which they had prepared low down in the flèche, and drove off their assailants who, however, recovered the flèche by a counter-attack.

Here the 4th parallel was opened, and shafts sunk to 38 ft., the level of the defenders' lower tier of countermine galleries, which were broken into on 4th August, and the powder hose severed. The defenders erected a barricade which was blown down on the 8th, and the further progress of the besiegers was only prevented by throwing earth and bombs down a ventilator and so blocking the gallery. On the 16th and 27th August the defenders blew up batteries placed to fire on the demilune de Secours, but, compelled gradually to retreat, they prepared countermines under the position of the expected breach, and fougasses in the ditch.

By the advice of Vallières, Commandant of the Miners, the French had commenced two galleries with the intention of blowing in the flèche of the demilune de Secours, but these were discovered, and on the 14th July the Piedmontese fired a countermine which broke up both galleries and buried miners and grenadiers. The air in the galleries was so bad for some days afterwards that they could not be entered again until fresh air had been pumped in by forge bellows connected to tin tubes.

On the 21st July the French blew up a palisade and captured the flèche, and next day discovered a ventilator which appeared to lead to the defenders' lower countermine gallery. Careful investigation showed the possibility of excavating a channel and bringing water about 1,200 yards to flood this gallery. This work was finished on the 3rd August, and the water turned on. On the 9th the lower gallery was opened, and it was found that the inundation had prevented the firing of several mines. However, the defenders had blocked the gallery and not much progress was made.

On the 13th July, before capturing the flèche of the demilune de Secours,

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the French had managed to find and break into the defenders' upper countermine gallery. They were on a higher level, and lowered three men one after the other, who were shot at once. A man with a shield then went down and managed to place some sandbags to cover the descent of others, and a hot fire was carried on until the smoke made the gallery uninhabitable.

The French had now reached the gorge of the flèche and, after a few mines had been fired by the defenders with little effect, were lulled to a false sense of security in the hope that their inundation of the lower gallery had produced the desired effect. They forgot the upper tier of galleries to which the Piedmontese still had access from the counterscarp gallery of the demilune de Secours. A battery of 16 guns and some mortars was established on the flèche, whereupon the defenders drove four branches under it, on the level of the ditch, from the counterscarp gallery. On the morning of the 24th the French were firing their first salvos, and looking for the early fall of the walls, when the four mines were fired, and destroyed all but three of the guns. The attackers fled, many falling under the fire from the walls. Some of the damage was repaired that night, and on 25th four guns opened fire, two of which were destroyed by a fresh mine. On the night of the 26th an assault was made on the demilune and the two bastions, the counterscarp was blown down, but the escarp had hardly been touched, and the attack failed.

It has been said that the upper countermine gallery was entered from the ditch. A ladder led to the lower gallery. On 29th August four French miners with shields descended into the ditch, and managed to reach the entrance to the gallery. They were killed by the guard, and three more met the same fate. A dozen more followed, and overcoming the guard, obtained possession of the entrance. A mine had been prepared in case of need, and as the guard retired by the lower gallery, the last of them, Pierre Mica, set fire to the hose. The explosion killed him, but also killed all the assailants. A monument was afterwards raised to his memory in the arsenal.

On the 31st August a second general assault was attempted and again failed. During the action the defenders fired a mine under the re-entering place of arms, between the Amédée Bastion and the demilune de Secours, destroying two guns of a 4-gun battery, and almost annihilating two companies of grenadiers, the survivors of whom fled. The remaining two guns were destroyed by the Piedmontese, and one gun which had been blown into the ditch was recovered and mounted in front of the Governor's residence. One of the defenders' mines under the place of arms had failed to explode. This was rectified, and the mine was fired on the 5th September, when two guns which had recently been brought into action were destroyed.

The subterranean battle in front of the Amédée Bastion proceeded all through the siege, but presents no interesting features. It was less vigorous in front of the Susine Gate and the hornwork. Some mines of the defenders had delayed the attackers' works there, and they concentrated all their efforts against the citadel, which was the key of the position.

At the end of August a French field army, under the Duke of Orleans

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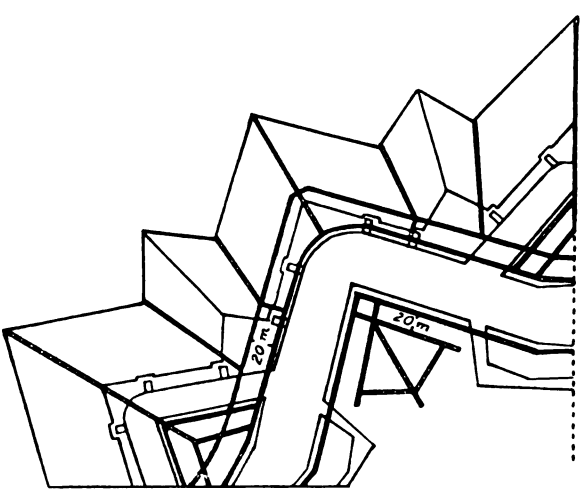
and Marsin, took refuge in the besiegers' lines, but la Feuillade would not attempt a general assault, and gave time to Prince Eugène and the Duke of Savoy to cross the Po, and attack the field army, which was defeated. la Feuillade tried to intervene, but in vain, and was forced to raise the siege, after destroying his magazines and abandoning his artillery.

It is undeniable that the system of countermines prepared beforehand saved Turin, and although the defenders were short of powder they used their resources to the best advantage. la Feuillade's plan had been anticipated and provided for, and though several engineers besought him to accept Vauban's scheme, he was too proud to do so. His engineers deserve all praise. They sacrificed themselves to secure the success of a plan in which they had no confidence. Vauban himself offered to serve under la Feuillade, but Louis XIV. would not permit him to do so.

Count de Mesgrigny, who had served as an engineer in numerous sieges, was appointed in 1668 King's Lieutenant of the Citadel of Tournai, which was then being constructed. He there carried out the system of countermines which bears his name. The town was defended by a simple enciente, with the addition of a citadel of five bastioned fronts, having demilunes between the bastions, and tenailles in front of the curtains.



System of Countermines of a front of the Citadel of Tournai.

de Mesgrigny employed two escarp galleries, one close behind the revetment wall from which to advance to meet the enemy and dispute the passage of the ditch. This gallery was prolonged under the tenailles to prevent the system from being turned. The second gallery was 25 yards in rear, and was intended to facilitate blowing up lodgments formed in the breaches. There were other galleries in the bastions for a step-by-step defence.

In the demilunes were two similar escarp galleries, and the mine defence

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of the interior was secured by prolonging the main counterscarp galleries. One of these ran under the covered way and the gorges of the demilunes, the second was 25 yards in front of it, and there were listening galleries running out under the exterior and interior angles of the glacis. No bastion or demilune could be taken without being breached, and to effect that the covered way must first be crowned; the second, or outer gallery, was to prevent this crowning. When that gallery was destroyed, the gallery under the covered way would enable the batteries overhead to be blown up, delay the breaching operations, and prevent a descent into the ditch. The only defect worth mentioning was the want of a counterscarp gallery in front of the demilunes.

Tournai was invested at the end of June, 1709, by Prince Eugène and Marlborough. Favart directed the engineering operations. There was no reserve of provisions in the fortress, the garrison of 6,000 men existed on what they could extract from the inhabitants, which was only grain, and the necessity of using water for grinding it prevented the ditches being flooded. The Allies were 50,000 strong with numerous artillery. Trenches were opened on the night of the 7th of July, on the 29th the town capitulated. The citadel held out longer in order to keep a besieging army occupied, and prevent it from joining the field army.

de Mesgrigny was 80 years old, but insisted on directing the operations. He had only 52 miners; the besiegers, under Count de Lottun, had 200 of the Piedmontese who had all served at the defence of Turin. The attack was directed against one front, and half the two adjacent fronts. Early in August the defenders made a sortie, and remaining in the covered way enticed the besiegers over three mines in the glacis, which were fired, and shortly afterwards some of the besiegers' works were damaged by mines.

On the 8th another body of troops under General Schulembourg arrived and attacked the citadel on the opposite side. The countermine defence was so active that neither attack could make much headway. On 13th August de Lottun's troops carried the covered way and managed to enter one of the countermines, where they found, and destroyed or removed, 4 tons of powder, but, in spite of this, explosions of other mines compelled them to vacate the covered way. A similar attempt on the 15th met with the same result. On the 16th the Allies on the opposite front managed to penetrate a countermine gallery and establish themselves there, but were checked by a barricade. This was their first real advance, for not being able to secure the covered way, they were unable to breach the escarp, of which the edge only was visible from their batteries. Their mines had hitherto been of little effect.

On the 19th two battalions were annihilated in their trenches by countermines, and on the 20th several soldiers and miners were crushed in the ditch by the blowing up of part of the wall of the town. On the 23rd the gallery which had been captured by the Allies was blown in, and several miners were suffocated in it. A battery of mortars erected by the assailants between the town and the citadel was next blown up, but a sortie following on this success was repulsed, and the besiegers were only prevented from entering the citadel by the explosion of another mine, which however also killed a number of Hanoverians.

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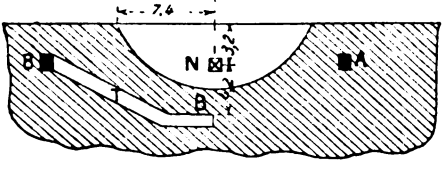
On Schulembourg's side the besiegers now established a battery on the covered way, and as they had previously exploded a mine on the site of their lodgment, considered themselves secure. However on the 24th a portion of the guard in the trenches was blown up. On the 26th the bursting of a mine exposed several countermines, but the defenders blew up part of the ditch on the town side where 800 of the besiegers had assembled. Many of the besiegers' miners deserted, and were sheltered by the inhabitants in spite of the dire penalties which were threatened for such behaviour.

Failure of provisions led to the capitulation of the citadel, and the garrison on the 3rd of September was allowed to depart with the honours of war. The underground war had lasted 51 days, and this lengthy defence, in the face of famine, was entirely due to de Mesgrigny's countermines.

Amongst the engineers who have made the corps of miners famous, Belidor is the most celebrated by his efforts to uproot the "invariable crater" myth. He was professor of mathematics at the school of La Fère, and evolved the theory that increasing the charge of a mine increased almost indefinitely the radius of the crater. He called his mines "globes of compression" and in 1725 commenced experiments to prove his theory, which had been vehemently attacked by many engineers led by Vallières, Director-General of the Artillery College.

He dug four shafts, C, D, E, F, 10 ft., 11 ft., 12 ft., and 13 ft. deep respectively at the angles of a square of 24 metres side, and joined their bases by four sloping galleries each 1 m. wide by 1·44 m. high. These were lined with oak, and had been excavated in compact clay, except that the bottom of Shaft C was in a wide and deep bed of hard marl. A mine N, 10 ft. deep, was placed at the end of a cranked gallery. The centre of the charge was 8 m. from the gallery CD, 9·6 m. from DE, 11·2 m. from EF, and 13·5 m. from FC. A branch ramped gallery



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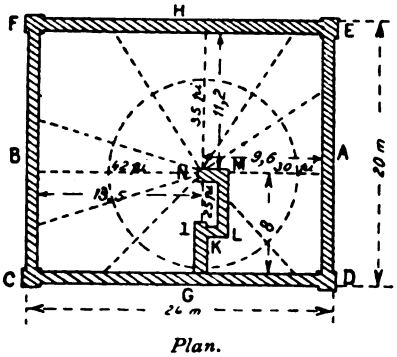

Plan.

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T was excavated having its top 4·2 m. below the centre N. According to Belidor the charge for a common mine should be 100 lbs. of powder; he fired 13,200 lbs. The radius of the crater was 24¼ ft., more than double the line of least resistance. All the galleries were staved in for lengths "almost in inverse proportion to their distances from the mine." The gallery beneath was broken in, also the two shafts D and E nearest to the explosion.

The success of this experiment did not convince his opponents, and in 1753 Louis XV. directed that official trials should be made at Bizy. These were carried out, in the presence of many distinguished officers, practically on the same lines as Belidor's, except that the galleries were lined with masonry. The mine was 13 ft. below ground, the crater was 17 ft. deep, and 66 ft. in diameter. The charge had been 3,000 lbs. The galleries were all shattered for nearly their whole length. Little impression was made in France by these experiments, and the celebrated engineer, Delorme, did not profit by them at the Siege of Berg-op-Zoom, but abroad, especially in Germany, the results were received with enthusiasm. Lefevre, who was in service with the Great Frederic, repeated them with like results at Potsdam, and applied them at the Siege of Schweidnitz.

In 1747 a French army under Count de Lowendhal laid siege to Berg-op-Zoom, which had been fortified by Cohorn, and was reputed impregnable. The attack was directed against the front from the Cohorn Bastion to the Pucelle Bastion. Opposite the curtain was a large demilune, flanked by two lunettes. There was a covered way 22 yards wide in front of all these works, which were revetted and had dry ditches. The countermine system consisted of a main counterscarp gallery from which led four listeners about 45 yards long. It was reached by gates opening on the ditch, and by two galleries from the demilune, passing under the ditch. Cut stone troughs had been provided for the powder hose.

The underground warfare presents few features of interest. It began on the night of 26th July (thirtieth of the siege) and by 16th September the counterscarp walls opposite the right flank of the Pucelle Bastion, the left flank of the Cohorn Bastion, and in front of the demilune, had been blown into the ditch, both lunettes had been captured, and there were two breaches in the escarp walls of each bastion, and one in the escarp on the right of the demilune. A general assault through the breaches, by escalading, and by the postern gate, was delivered on that day, and the place was captured.

Four-fifths of the total length of the siege was occupied in crossing the glacis, and as during all that time a violent fire of musketry, guns and mortars had been maintained, a large proportion of the fatalities of the besiegers may be attributed to the slowness of their works, due to the defenders' countermines. At the same time the sandy nature of the soil presented almost insuperable difficulties to the engineers of the attack, from a great deal of which the defenders were saved by their masonry galleries. The latter do not seem to have extended their galleries at all until after the commencement of the siege, but, knowing the treacherous nature of the soil, had collected large stores of oak

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mining cases of a pattern which afterwards came into general use under the name of Dutch cases. It is worthy of note that at this siege the French did not repeat the error they committed at Turin, but took care to clear the enemy out of the ground beneath before they established their breaching batteries. Only the epaulment of one of their batteries was damaged by mines.

A rapid method of sinking shafts introduced by a Capt. Boule was made great use of for reaching the base of the counterscarp walls and blowing them down. A shaft of about 18-in. side is excavated by means of spades, or scoops, shaped like a hoe, with handles from 3 ft. to 18 ft. in length. The earth is dragged out by baskets attached to a rope. When at the required depth a box is lowered filled with 150 lbs. to 200 lbs. of powder, the hose is fixed to one side of the shaft, the earth is thrown back and rammed to tamp the charge, and the mine is ready to fire.

In 1762 a Prussian army under Frederic the Great arrived to recapture Schweidnitz, which had been taken by surprise by the Austrians the year before. Trenches were opened on 7th August. The attack was directed against three of the exterior forts, that against No. 2 being the principal. The forts were of star trace, with dry revetted ditches, and the intervals were organized for defence. A covered way, with a wall outside it, ran continuously along the front of forts and intervals.

Five countermine galleries ran from the three front salients of Fort 2, and from the two re-entrants between them, reaching to beyond the toe of the glacis. Each gallery from the salients branched into three, each of which ended in a tee, and the galleries from the re-entrants also ended in tees. By this means the whole front was embraced. The mine attack was limited to the ground round the central salient system of galleries only.

Under the direction of Lefevre mining began from the third parallel on the 22nd of August, and on the 28th had advanced about 85 ft. when the defenders made a sortie, discovered the entrance to the mine which they filled with bombs, stink balls, and barrels of powder, and blew up. The sortie then retired with several prisoners, from whom details of the mine scheme were obtained. It was calculated that the galleries would pass about 7½ ft. below the countermine galleries, and measures were taken accordingly. The besiegers repaired their damaged gallery, but on the 30th having advanced about 100 ft. had to stop for want of air. It was decided to charge a mine chamber with 5,500 lbs. of powder with L.L.R. of 17½ ft. Tamping was completed on the 1st of September, and the first "globe of compression" was fired. A crater 20 ft. deep with a radius of 42½ ft. was formed. No damage was done to the Austrians, but the crater was crowned, and next day a fresh gallery from it was put in hand. On the 4th of September a small countermine of 165 lbs. powder was fired, but had no effect except to make the Prussians more wary.

The happy idea now struck the Austrians of joining up the T-heads of their countermine galleries. This much improved the ventilation, and enabled them to work towards the flanks of the besiegers' mines without fear of their retreat being cut off. The Prussians now came

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across water, and had to abandon their gallery from the first crater and begin a second. On the 9th the Austrians damaged this with 150 lbs. powder with L.L.R. of 20 ft. and 30 ft. of tamping.

Next day the Prussians repaired their gallery, and when they had advanced about 80 ft., came across a branch of the defenders, who, however, contrived to explode a small mine, and destroyed about 65 ft. of the attackers' gallery. Thus 10 days after their first explosion, the attackers had to begin a third gallery from their crater. On the 16th the air in this gallery was so bad that it was decided to charge a second globe of compression of 2,200 lbs. of powder. 40 ft. of tamping was given, the crater was 16 ft. deep, and had a radius of 33 ft., but only one of the defenders' branches was damaged.

From their second crater the Prussians now commenced a new gallery, which was broken up by two camouflets each of 50 lbs. of powder. It was repaired, and another gallery parallel to it was started. These were both destroyed by camouflets on the 18th. Two new galleries met the same fate on the 19th and 20th.

Lefevre now almost lost heart, but Frederic ordered him to proceed again, and drive a gallery under the countermines for a large globe of compression, and a higher gallery to attack the countermines by camouflets. The higher gallery was discovered and damaged by a camouflet of 150 lbs. powder on 22nd, but was recommenced to distract attention from the lower and more important gallery. The latter was only 23 ft. long when countermining was heard on both sides of it. In spite of the short length available for tamping Frederic ordered a return to be excavated and 4,000 lbs. powder to be placed in it. This was successfully accomplished, and on 24th September the third globe of compression was fired, producing a crater 20 ft. deep with a radius of 33 ft. Some of the defenders' branches were damaged, and two of their miners killed, but neither the palisade nor covered way were touched. A great deal of the effect took place backwards, owing to the short length available for tamping.

Excavation was again put in hand, but by the 26th of September the defenders were threatening No. 3 Crater with five mines on the left, and one on the right. At midnight the firing of the latter gave the signal for a sortie, which was pressed with such vigour that the besiegers were driven back into No. 1 Crater, and to their third parallel. No. 2 Crater was crowned against them and all their works between that and the fort were destroyed. The defenders then retired from No. 2 Crater, and on 28th the besiegers began to drive a gallery from it under No. 3. A camouflet fired against this gallery left it unharmed, but a miner was suffocated by the fumes.

On the 8th of October when this gallery was 105 ft. long the Prussians observed a high column of smoke burst from the fort. A small magazine had been accidentally blown up. The only profit the Prussians drew from this mishap was time to charge their fourth globe of compression, which was 25 ft. deep, with 5,500 lbs. powder. The defenders then fired a small camouflet of 60 lbs. of powder which they had already prepared, but it was too high above the attackers' mine, and did no damage. A larger charge might have breached the palisade of the covered way.

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The fourth globe of compression was tamped for 52 ft. (twice the L.L.R.) and made a crater 39 ft. in diameter, threw down the salient, and completely demolished the countermine system. The ditch was so filled with débris as to allow of an assault being delivered. Next day the place capitulated.

What especially characterizes this siege is the open and direct advance of the mine attack on one line. The first globe was evidently fired at too great a distance from the fort. It would probably have been better, if, instead of a series of successive discharges, several globes had been prepared at short lateral intervals. There would not then have been the same risk of failure. However this may be, Belidor's globe of compression did not emerge from this test absolutely triumphant, and the reputation of countermines augmented to such an extent that, if the attackers knew that countermine galleries existed on any front, they preferred to confine their efforts to another front, and replace subterranean war by bombardment or blockade.

Besides the systematic establishment of permanent countermine galleries a characteristic of the third period of subterranean warfare is the close tactical connection between the miner and the artillery. Breaching batteries were of short range, and to be of any use at all had to be established as close as possible to the ditch. The certainty of having command over the subsoil was therefore of paramount importance. Neglect of this principle led to various disasters at Turin, while at Berg-op-Zoom the activity of the attackers' miner allowed the breaching batteries to be established in safety. The miner was therefore at this stage an indispensable auxiliary to the siege artillery.

A.R.R.

(To be continued).

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NOTICE OF MAGAZINE.

RIVISTA DI ARTIGLIERIA E GENIO.

May, 1914.

ARRANGEMENTS FOR RENDERING THE WHEELS OF CARRIAGES MORE ELASTIC.

Some years ago there appeared in the pages of the *Rivista* certain proposals for the improvement of heavy wagons, for accelerating their movements over sunken and bad roads and for crossing ground broken by furrows, drains, stones and roots, without injury to the preservation of the vehicle, and without compelling the drivers to dismount. The disadvantages noted above refer principally to artillery, and proposals were made for a system for diminishing the great rigidity of its heavy carriages.

The author of the article with the above heading is Giuseppe Taraglio, Technical Superintendent of Artillery and Engineers, and he has studied the problem as one of interest not only for artillery, but for all kinds of wheeled traffic. Towards the end of 1908 he arrived at a solution and carried out experiments which appeared to verify the conclusions that he had before arrived at theoretically. He bases the solution of the problem on the elasticity of the air enclosed in a metal cylinder attached to carriages at a convenient height above the ground, in which a piston can work, of an appropriate form and construction. The various parts of the mechanism, as much in the piston as in the other portions of the system, function in a manner that the elastic reactions produced in the cylinder result in complete proportions within certain restricted limits, and act in opposition to the effects of the shocks on the wheels which are caused by the inequality of the ground. The mechanism is very simple and can be applied to all kinds of carriages.

Description of the Mechanism.—Suppose (see *Figs.* 1 and 2) a wheel attached to an axle 17, connected with the extremity of the arm of a lever whose fulcrum attached to the axle-tree has its other arm fastened to a spiral spring 21, that has its head at the framework of the carriage. It is evident that such an arrangement would not of itself be sufficient to absorb the effects of shocks to the wheels (i.) because it is based on the action of the spring which would not serve for this purpose: (ii.) for great variations of shocks of various velocities the vehicle would sometimes have an accelerated motion and on the wheels encountering a surmountable obstacle, the spring would be completely extended, and the weight of the carriage would act on the fulcrum of the lever as if there were no elastic organ. But if to the above-mentioned arrangement we add a cylinder fixed to the framework of the carriage in which works a piston in connection with the arm 20, by the spring (*Fig.* 1), we interpose to the system an elastic resistance caused by the air contained in the cylinder, which will impede the complete distension of the spring on encountering shocks to the wheels owing to inequalities of the ground. By this means the spring will vary in length only sufficiently to allow to the piston the necessary compression of air to counter-

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act the effect of the shock, and on this ceasing will tend to renew the primitive condition of the system. The spiral spring may also be placed in the interior of the cylinder as shown in *Figs.* 5, 6.

To regulate the work of the piston in a manner to obtain for each corresponding velocity a proportional pneumatic reaction for absorption of the effects of the shock and the desired smoothness of elasticity, the cylinder may vary in its length, and the piston can be furnished with a varying number of diaphragms and with holes of various sizes to admit of a greater or less passage of the air. As shown in *Fig.* 4, the cylinder is closed at the two extremities 3 and 4, the piston rod being first passed through perforated stuffing, 5. The piston rod is formed of a hollow cylinder that carries a head, 7, and some diaphragms, 9, 10, 11, varying in number according to the degree of elasticity required, which divide the head of the piston into spaces 12, 13, 14. The perforation 8 in the head and in the diaphragms permit the passage of the air between the portions 15 and 16 of the cylinder traversed by the piston. The number of diaphragms may vary according to the kind of vehicle, in some cases it may be sufficient for only the head to be perforated, and in others to leave a convenient space between the cylinder and the lateral surface of the piston. Also, the number and size of the small perforations may be varied. The piston with its movement within the cylinder causes compression and rarefaction of the air in the two spaces into which the cylinder is divided, thus tending to re-establish equilibrium.

The passage of the air through the perforations in the diaphragms renders the resistance to the movement of the piston more elastic. If the shock is slight the pressure developed in the interior of the cylinder is also small, and the air issues from the holes with moderate velocity; if however there is a strong shock, the pressure increases owing to the more rapid movement of the piston, and the air issues with greater velocity through the perforations. It is evident that the resistance of the spiral spring maintains the equilibrium and tends to replace the piston in its initial position. The lubricating oil interposed between the surface of contact of the cylinder and the piston prevents the escape of the air.

The wear and tear of the tyres of the wheels of vehicles, automobiles, bicycles, motor cycles, etc., will also be much lessened by this system. The method above described can be applied with advantage not only to carriages, which now have india-rubber tyres (bicycles, motor cars, etc.) but also to other vehicles and all kinds of military wagons. The arrangement shown in *Fig.* 5a serves for wagons and for the carriages of field artillery; in the latter the suspension can be rendered rigid by the use of a bolt, 26, which when introduced in an appropriate position prevents the friction on the frame of the carriage.

Fig. 7 shows the arrangement for bicycles, 3a for autocars and heavy wagons, 1a, 2a, and 6a for automobiles.

Experiments are being made which apply to bicycles with inflated tyres (*Fig.* 8) and with very satisfactory results. For volunteer cyclist detachments the bicycles furnished with the suspension arrangement above described offer great advantages. The experiments will also be continued with carriages of various kinds.

E. T. THACKERAY.

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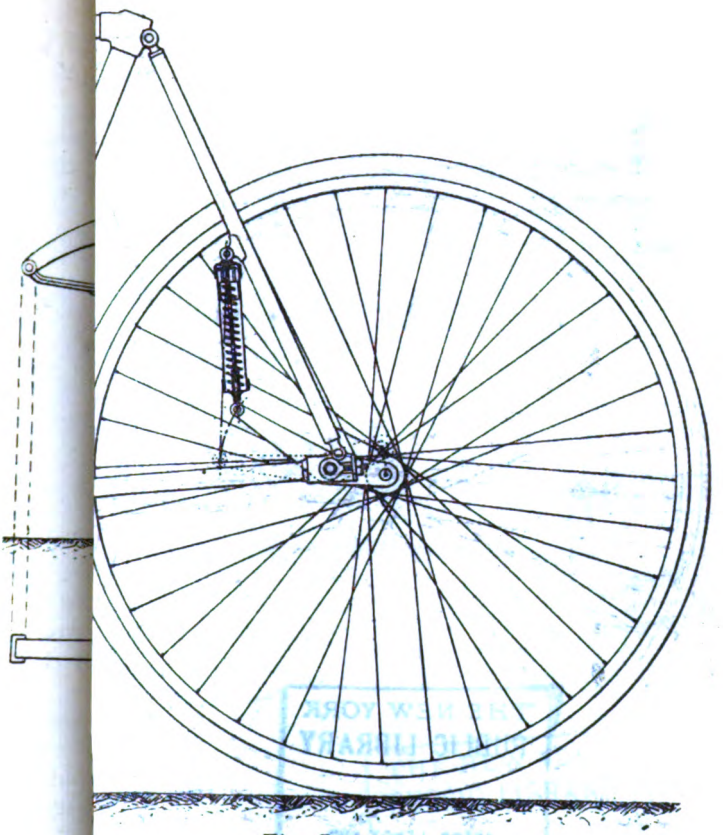

Fig. 7.

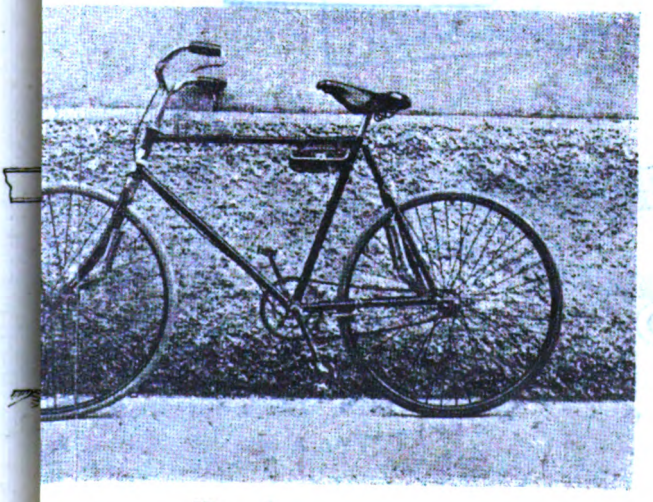

Fig. 8.

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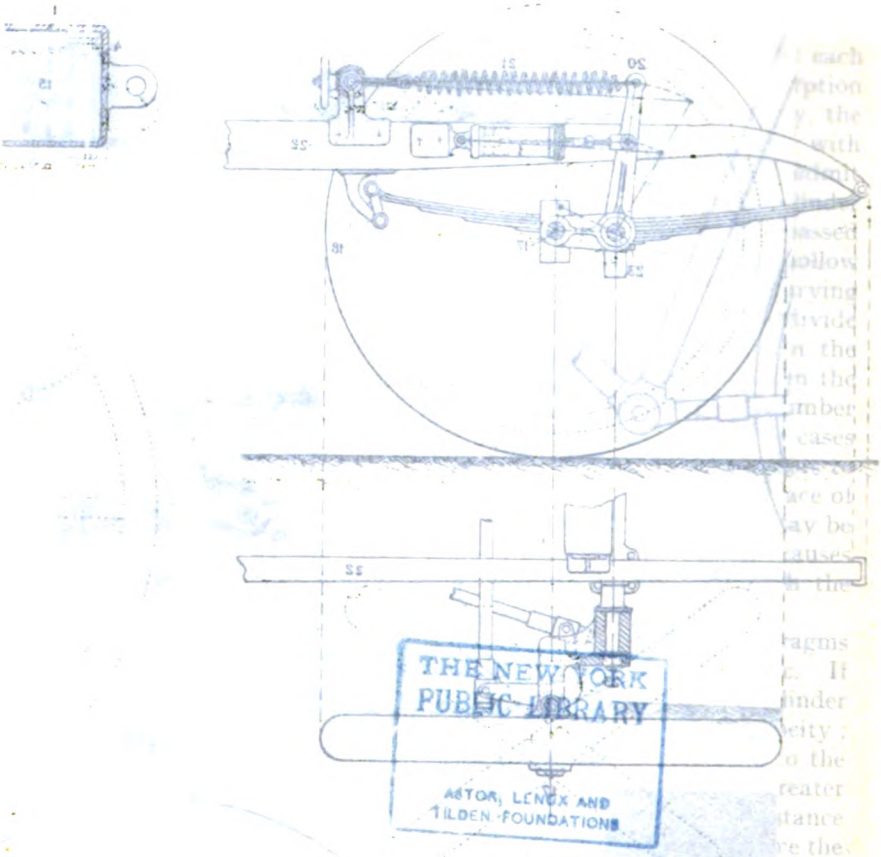

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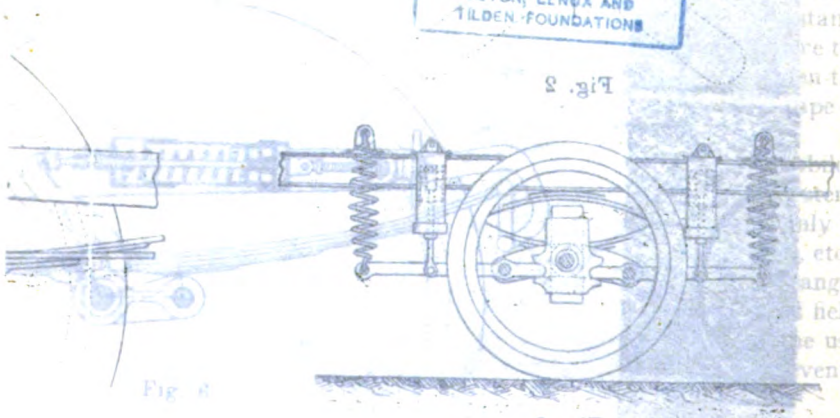

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BANGALORE IMPROVISED GRENADE.

(IN USE AS RIFLE GRENADE).

To show:—I. Method of Firing—(*a*). With fixed rest; (*b*). Without rest. II. Sighting Expedients—(*a*). Indirect aiming with Plumb-Bob Clinometer; (*b*). Direct aiming along Dial Sight Pointer. III. Quiver for carrying Grenades and Range Table inside its lid.

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AN EXTEMPORIZED RIFLE GRENADE.

THE BANGALORE "UNIVERSAL" GRENADE.

By MAJOR R. L. MCCLINTOCK, D.S.O., R.E.

I. PRELIMINARY REMARKS.

IN the *R.E. Journal*, April, 1913, appeared an article describing "An Extemporized Hand Grenade." The second paragraph of this article ran as follows :—

"Hand grenades are essentially articles which lend themselves to improvisation. The opportunities for their use are so rare, and they are so weighty, bulky, and costly as compared with rifle ammunition, that carting them about with an army in the field would seldom be worth while. They are accordingly most unlikely to be found on the spot when suddenly required."

The same remark applies equally to the "rifle grenade." The two are, in fact, identical, except in so far that the latter, deriving its initial velocity from a charge of cordite instead of from the muscles of the human arm, has a range tenfold greater. This comparatively long range, together with the steep angle of descent and powerful explosive effect of rifle grenades, renders them well adapted for searching cover which is proof against direct fire, and so peculiarly suitable for siege operations. Nevertheless, "Mafekings" are so rare that no army is likely to devote transport to rifle grenades, if it means displacing an equivalent weight of ball ammunition.

The remedy, as before, is to arrive at an efficient type of rifle grenade which need not necessarily be of factory manufacture, but which can be turned out rapidly by the artizans of the R.E. field companies when required in emergency.

The following is the result of a very considerable number of experiments carried out at Bangalore with this object. The principle of propulsion from a rifle by means of a rod down the barrel has been adopted from that used in "Hale's Rifle Grenade," manufactured by the Cotton Powder Co. of Walbrook. The actual *grenade*, however, is a development of the extemporized hand grenade previously described. The outcome, "The Bangalore Improvised Grenade Mark II., Universal Pattern," is not in any way intended to compete with Mr. Hale's invention ; its *rule* is merely that of a cheap and easily extemporized substitute for the latter in case of emergency. Hale's grenade is not so far an article of Ordnance Store supply, and

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thus is unlikely to be at hand if required for use in a hurry—at any rate outside Europe. It is further a machine-made article of a pattern impossible to improvise in the field.

Simplicity has accordingly been made the first aim in the design of the Bangalore grenade, so that native workmen may be able to turn it out rapidly with the common tools to which they are accustomed. Similarly, the materials and explosives required in its construction have been rigidly limited to those either actually carried by a field company of Sappers & Miners, or which are readily obtainable in India.

Arrangements have further been made to adapt it for throwing by hand if necessary with either time or percussion fuzes.

II. DESCRIPTION.

1. *Body.*—The body of the grenade is a metal tube, $5\frac{7}{16}$ in. long and $1\frac{3}{4}$-in. internal diameter. The best material for this tube is ordinary block tin, but the metal from kerosine oil tins, biscuit, or cartridge boxes can also be used. A circular hole, of $\frac{3}{8}$-in. diameter, is first punched in this tube with its centre 1 in. from one end, hereafter called "the top." This hole is called the "Safety Port" *b*, *Fig.* 1.

Next, two holes are punched for the "Safety Pin" (*f*, *Fig.* 9). These come $\frac{1}{4}$ in. down from the top of the tube, one directly above the safety port (*b*), and the other diametrically opposite the first. For size of pin, see para. II., 4.

Finally, eight holes are required for the $\frac{5}{8}$-in. screws which secure the wooden plugs (*h*) and (*r*) to the tube (*vide* paras. II., 2 and 8, and *m*.M, *Fig.* 5). The exact position of these is immaterial, as long as they are evenly distributed round the plugs, and do not interfere with the wires (*w*) and (*p*), (*vide Figs.* 6 and 7).

2. *Cartridge Plug.*—This is a cylindrical plug of hard wood (*h*, *Fig.* 5) $\frac{3}{4}$ in. long and of diameter sufficient to fit tightly within the tube. It is placed inside the latter with its top surface $1\frac{1}{8}$ in. from the top of the tube. It is secured in position with four $\frac{5}{8}$-in. screws (*mm*) passing through the tin and distributed evenly round the circumference of the tube.

Through the axis of this plug a hole is previously bored, just large enough to admit and hold a Lee-Enfield, or ·450 revolver, cartridge case (*vide* para. II., 6, and *x*, *Fig.* 5). The top of the hole is slightly countersunk to let the base of the case lie flush with the top surface of the plug.

3. *Striker Plug and Striker.*—This is another cylindrical plug of hard wood (*k*, *Fig.* 5), $1\frac{1}{8}$ in. long and of diameter just sufficient to let it slide freely, but not loosely, within the tube. It has a nail or screw (*i*) fixed axially in one end, and then filed to a blunt point pro-

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jecting ¼ in. from the wood. Now, if this plug is dropped into the top of the tube, the point (*i*) will rest on the cap (*x*). The other end of the plug (*k*) will still project ⅜ in. from the top of the tube, and a blow on it will explode the cap.

4. *Safety Pin.*—To prevent this happening accidentally, the point of the striker (*i*) is raised ⅛ in. above the cap and held there by means of the "safety pin" (*f*).

This is a piece of stiff iron wire (say, telegraph wire 75 lbs. to the mile, or a 2-in. wire nail) which passes through the two holes in the tin tube, and also through a hole across the plug (*k*), thus locking it to the tube. This pin can be withdrawn at will.

5. *Retaining Wire.*—If the safety pin were thus withdrawn, and the grenade inverted, the plug (*k*) would fall out. To prevent this, it is secured to the tube by the "Retaining Wire" (*e*, *Fig.* 1). A tack is driven into the top of the plug (*k*), a turn of the wire taken round this, and the two ends then similarly made fast to any two opposite screws *mm*. Any thin wire, or string, will do.

This arrangement prevents the striker plug (*k*) leaving the grenade accidentally after the safety pin is withdrawn, but still permits it (under a blow) to descend on the cap (*x*) and explode it.*

6. *Explosive Charge.*—Below the cartridge plug (*h*) comes the charge (*ss*), composed of two 1-oz. gun-cotton† primers.‡ That next the cartridge plug has a Nobel's octuple detonator (*y*) fixed in it, the shank projecting up as far as it will go into the cartridge case. As a 303 case is longer than the cartridge plug, it must be cut down with a file to the necessary length (¾ in.). A ·450 revolver case can equally well be used, and requires no cutting. The whole of the cordite, or other explosive, should be removed from the case, the cap alone being sufficient for the ignition of the detonator.

The detonator being a good deal longer than a single primer, it will project both upwards into the case, and downwards for a certain distance into the lower of the two primers, thus skewering them together. To prevent the detonator from shifting downwards under the shock of discharge, the remainder of the central hole of the lower primer should be closed with the wooden "filler" (*d*, *Fig.* 5).

* NOTE.—To prevent this happening prematurely at the moment of discharge, there is a further safety arrangement. This, however, it will be more convenient to describe later, *vide* para. II., 11 and 12.

† NOTE.—It will be noted that the O.P. *cylindrical* 1-oz. gun-cotton primer is shown in *Plate*, as this is still issued in India. There is no difficulty, however, in adapting the N.P. *conical* primer to the same use.

‡ NOTE.—Dynamite can also be used. First a tin or paper cylinder is made of the same size as the two primers, *i.e.*, 2½ in. long by 1¼-in. diameter. Dynamite is warmed till plastic and pressed into this cylinder, which will hold about 3 ozs. A hole is made for the detonator in the usual way, and this cartridge used in lieu of the two primers.

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7. *Projectile.*—To increase the man-killing powers of the grenade, a segment projectile (*nn*) is added. This consists of 22 segment bars (*n*), each 2½ in. long (*i.e.*, the same length as the two primers), made of $\frac{3}{16}$-in. square iron rod. To assist these bars in breaking up into uniform segments on explosion, each is notched in two places with a cold chisel, thus giving 66 segments, running about eight to the ounce. These segment bars are inserted between the primers and the tin tube, so as to surround the former completely (*vide Fig.* 6).

8. *Bottom Plug.*—The lower end of the tube is closed, and the whole contents kept snug, by a third plug of hard wood (*r*), 1 in. long and of the same diameter as the cartridge plug (*h*). This is faced on the upper surface with three tin discs (*c*), secured to it with a couple of tacks (*uu*).* The plug is thrust into the tube from the lower end, and should grip the charge tightly between itself and the plug (*h*). It is secured in this position with four ⅝-in. screws (MM) distributed evenly round its circumference. Through the axis of the plug is bored a ¼-in. hole, and round it, as centre, in the upper surface of the plug is countersunk a recess ½ in. square and $\frac{3}{16}$-in. deep. This hole and recess are for the attachment to the grenade of the "Tail Rod" (*a*). A tin clip (FS, *Fig.* 8) is secured to the bottom surface of this plug with a tack (U) and the "Tail Rod" (*a*) which passes through it.†

9. *Tail Rod.*—This is a round mild steel rod, ¼ in.‡ in diameter and 18 in. long. It is threaded for 1¼ in. at the top end to take a square iron nut of ½-in. side. Two such nuts are required. One the "Bottom Nut" (T) is screwed down the rod till only 1 in. of the threaded end protrudes from it. The other, the "Top Nut" (*t*), is placed in the recess in the upper surface of the plug. The threaded end of the rod is then inserted into the hole in the plug and screwed through it into the top nut (*t*), till its upper end is flush with the upper surface of plug and nut. The bottom nut (T) is then screwed up till the plug (*r*) is gripped rigidly between the two nuts. The lower end of the tail rod (*a*) is filed to a neck (*vide Fig.* 5) to fit into the "Gas Check" (*g*).

10. *Gas Check.*—This is the front portion of a hard-nosed ·303 bullet, cut off about ⅝ in. above the base (*g*, *Fig.* 5). If cut off at the proper point it will just go down the barrel of a rifle from the muzzle. This gas check is fixed to the lower end of the tail rod (*a*) by drilling a hole in the nose of the bullet, inserting the end of the tail rod (which should be coned as shown), and securing in position with a drop of solder. A small tin disc (*v*), soldered to the base of

* NOTE.—These tin discs act as a wad between the end of the tail rod (*a*) and the charge. They prevent the former being driven into the latter, should the threads of the nut (T) strip when the rifle is fired.

† NOTE.—For the object of this clip, *vide* para. II., 11.

‡ NOTE.—This is the nearest commercial size to ·303 calibre.

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the gas check, is useful in protecting the lead at the moment of discharge. It tends to produce more regular results, but it is not indispensable.*

11. *Safety Spring and Plate.*—Now, if the grenade has its tail rod inserted into the barrel of a rifle, and is propelled from it so that it may land on its head, explosion should result, if the safety pin has been duly removed. But, as by the removal of the latter the striker point would, at the moment of discharge, be free to impinge on the cap (*x*), the inertia of the plug (*k*) would tend to make it do so, and produce a premature explosion at the muzzle. The following device has accordingly been adopted to protect the cap from the striker point until the inertia of the plug (*k*) shall have spent itself.

A 8½-in. length of untempered steel wire, say, S.W.G. 20, (VWXYZ in *Figs.* 1, 3, 4, 5, 8 and 9, and " w " in *Figs.* 6 and 7), is bent at right angles at X, 2½-in. from one end. The long end of the wire is passed down the whole length of the interior of the grenade, being confined between the plugs (*h*) and (*r*) and the side of the tube by being housed in a slight notch made in each of the former. On emerging from the bottom plug at Y, it is again bent at right angles in the same plane, as shown in *Fig.* 5. The shorter end, XWY, now lies along the top surface of the cartridge plug. It is next bent at right angles in this plane at W, 1 in. from X and the tin " Safety Plate "† (*j*) soldered across this angle as shown (*Figs.* 3 and 4). Finally the end V is bent into the shape of a hook, and adjusted so that it will project slightly through the safety port (*b*) when the plate (*j*) is over the cap (*vide Fig.* 3).

Now taking the length of wire XY within the tube as an axis, the portion YZ can be rotated round this axis, either to left or to right (*vide Fig.* 8), till the end Z will approach the tail rod (*a*) on one side or the other. This end YZ can then be secured in either position by being hitched beneath either the small lug " S " or the large lug " F " of the tin clip FS, which is provided for this purpose.

The short end VWX of this same wire, which carries the plate (*j*), would naturally strive to conform to this movement of the end YZ. If it is restrained from so doing, the portion XY is placed in torsion. The wire being steel, as soon as the restraint is removed, the end VWX will conform as far as it can. It can only move within the limits of the tube, but it can still move far enough to assume either of the positions shown in *Fig.* 3 or 4. When it is in the former, the

* NOTE.—This gas check causes no damage to the rifle barrel. Over 200 grenades have been fired from one rifle at Bangalore without any ill-effects.

† NOTE.—Two thicknesses of block tin, soldered together, with the wire between them. With this plate between striker and cap, the grenade can be dropped on its head over 15 ft. on a hard surface without exploding.

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plate (*j*) protects the cap (*x*) from the striker. When it is in its *Fig.* 4 position, however, the cap is exposed.

This length of wire, VWXYZ, is called the "Safety Spring," and the end VWX is restrained when necessary in the *Fig.* 3 position by means of the "stop" (*p*).

12. *The Stop* (*p*).—The stop (*p*) is an 18-in. length of the same wire, bent in the middle to hairpin shape. It, too, runs along the inside surface of the tube, being similarly confined in a shallow notch made in each of the three plugs (*vide Plate*). It is so arranged as to cross the centre of the safety port (*b*) on the inside, and so engage the hooked end V of the safety spring, thus locking the latter in the position shown in *Fig.* 3. The withdrawal of this stop in a downward direction will obviously release this end V. Such withdrawal, however, is impossible as long as the safety pin (*f*) is in position, as this pin passes through the bend of the "hairpin," and so secures it in the grenade.

The two free ends of the "hairpin" stop are connected together below the grenade by the "Clutch" (*q*) (*vide Figs.* 1 and 9). This is a piece of tin 1 in. square, slightly bent across the middle, with two holes punched in it large enough to receive the two ends of wire side by side. The object of this form of connection is described in para. V., 6.

Now, when the end YZ of the safety spring is turned round and hitched beneath the small lug "S" (*Fig.* 8), the spring is in its "*Safe*" position. The torsion of the wire XY keeps the hooked end V in the safety port (*b*), and the plate (*j*) accordingly above the cap (*x*). The stop (*p*) passes through the hooked end V, but is doing no work, as this end has at present no tendency to leave the hole (*b*). If, however, the end YZ be turned round the reverse way and hitched beneath the large lug "F," the torsion of the wire XY is in the opposite direction, and tends to make the portion VWX assume its *Fig.* 4 position. It cannot do so, however, as the hooked end V is now held by the stop (*p*). The safety spring is now in its "*Fire*" position.

Should, however, the stop (*p*) be withdrawn downwards (the safety pin (*f*) having first been removed) the end VWX will at once fly across to its *Fig.* 4 position, and uncover the cap.

The effect of this safety device is described in para. V., 2.

13. *Weight and Length.*—The total length of the grenade, including tail rod, is $23\frac{5}{16}$ in. Its weight (loaded with gun cotton, and made of block tin and teak wood) is 1 lb. 5 oz., composed as follows:—

Charge (gun cotton, detonator, cartridge case) ..	$2\frac{1}{2}$ oz.
Projectile	$8\frac{1}{2}$,,
Tube, tail rod, blocks, etc.	10 ,,
Total	1 lb. 5 oz.

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III. Preparing for Use.

(1). The lower end of the safety spring YZ is unhitched from beneath the small lug " S " (the grenade is carried in its " *Safe* " position), turned round the axis XY in three-fourths of a circle, and hitched beneath the large lug " F," in its " *Fire* " position.

(2). The tail rod is introduced into the rifle muzzle and the grenade pressed down till the lower surface of the bottom plug rests on the " boss for ring of bayonet " of the rifle (o, *vide Fig.* 9).

The grenade will not go fully down unless the instructions of para. (1) above have been obeyed, as otherwise the rolled end, Z, of the spring interposes between the boss and the bottom plug. This prevents the grenade being fired with safety spring at " *Safe.*"

(3). The two returns of the stop (*p*), projecting below the grenade, are slightly separated and passed one each side of the right-hand horn of the foresight protector (*l*). The clutch (*q*) is now slid up the wires as far as possible, and straightened out between thumb and fingers to grip the wires tightly (*vide* V., 6, and *Figs.* 1 and 9).

(4). The propelling cartridge is now inserted into the chamber of the rifle. This is a service ·303 cartridge *with bullet extracted.*

(5). Last of all the safety pin (*f*) is removed, and the grenade is said to be " *Set.*" It is now ready to fire.

IV. Firing Positions.

Firing is best done from the sitting position, with the legs crossed and the butt resting on the ground between them. The left hand should grasp the rifle near the backsight, while the right holds the small of the butt, forefinger on trigger, *vide Photo.* The necessary elevation for any range is given in para. VI., and the means of obtaining it in para. VII. For deliberate work, such as siege operations, more accurate results can be obtained by using some sort of fixed rest, such as that also shown in the *Photo.*

V. Action.

(1). On explosion of the propelling cartridge, the gas check (*g*) sets up on the coned end of the tail rod (*a*), sealing the bore to the escape of gas. This would otherwise be considerable, as the diameter of the bore is ·303 in., while that of the rod is only ·25 in. The pressure thus obtained expels the rod, which drives the grenade before it and at the same time acts as a tail to keep it head first during flight.

(2). As the grenade begins to move away from the muzzle, the stop (*p*) is restrained from accompanying it by the clutch (*q*), which is held behind the right-hand horn of the foresight protector (*l*),

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and has a frictional grip on the two wires of the stop. The latter is accordingly pulled out of the grenade. This sets free the end V of the safety spring, which is in strong tension towards its *Fig.* 4 position. It would at once assume the latter were not the striker point (*i*) at that moment bearing heavily down on the plate (*j*) under the inertia of the plug (*k*). *As long as any pressure is exerted by the striker towards the cap, the plate* (*j*) *is thus held in place above the cap and the grenade is safe.*

As soon, however, as the plug (*k*) has lost its initial inertia, this pressure relaxes, the wire VWX whips across to its *Fig.* 4 position, and the plate (*j*) no longer covers the cap. The grenade, therefore, starts "*Safe*" but becomes active during flight.

(3). On impact with the ground, the weight of the grenade drives it forward on to the striker plug (*k*). The point of the striker (*i*) penetrates the cap (*x*) and the explosion of the latter fires the detonator (*y*) and so the charge (*s*).

(4). If the grenade after being "*Set*" is not fired, it is again rendered safe for carriage as follows :—

(*a*). Re-insert the safety pin, being careful that it both locks the striker plug (*k*) to the tube, and passes under the bend of the "hair-pin" end of the stop.

(*b*). Remove grenade from rifle and transfer the lower end of the safety spring from beneath the large lug "F" to beneath the small lug "S."

(5). It will be observed that, *as long as the safety pin is in position*, the stop (*p*) serves to attach the grenade to the rifle. This enables the grenadier to carry his rifle in any position without the grenade falling out.

(6). The object of the frictional connection of the two lower ends of the stop (*p*) by the clutch (*q*) is to avoid the danger of bursting the rifle, should the grenadier discharge it without first removing the safety pin. The abnormal pressure thus obtained overcomes the frictional grip of the clutch, and the stop (*p*) is released from the rifle by slipping through the former. The grenade, of course, falls blind, as the stop remains in it.

The frictional grip of the clutch is increased or reduced by straightening or bending the tin plate between the fingers. When straightened as much as possible by the aid of the naked fingers of one hand alone, the rifle can just be lifted by the grenade without the clutch beginning to slip, and this is the friction worked with at Bangalore.

VI. RANGE.

On a calm day, with the rifle elevated at 45 degrees, and the service cartridge (31½ grs. cordite), the grenade will fall about 230/250 yards from the muzzle. Shorter ranges down to about

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130/140 yards can be obtained by continuing to elevate the rifle till 70 degrees is reached.

To get still shorter ranges it is necessary to use reduced charges. The service cartridge contains 60 strings of cordite. Half and three-quarter charges are easily made by removing 30 and 15 strings respectively, and replacing the wad. By the combined use of these reduced charges and elevations between 50 degrees and 70 degrees, any range down to 50 yards can be obtained, *vide* the following approximate range table :—

Rifle Grenade.				Hand Grenade.
Elevation.	Charge.			
Degrees.	Full.	¾	½	
30	180	—	—	Can be thrown up to 40 yards.
40	220	—	—	
45	240	—	—	
50	220	180	90	
60	180	140	70	
70	140	100	50	

N.B.—A fresh breeze will make a difference of quite 20 yards in any direction.

For ranges less than 50 yards the grenade must be thrown by hand, *vide* para. VIII.

Although the elevation 30 degrees is given above, the use of elevations of less than 40 degrees is not recommended, as the grenade possesses its maximum efficiency when dropped as nearly as possible vertically into the target.

On a calm day the maximum range is given by an elevation of 45 degrees. With a head wind, however, 40 degrees is found to produce the best results, while with a following wind an elevation of 50 degrees gives the longest shots. From this it is evident that ascertaining the "error of the day" is a necessary preliminary to accurate practice.

VII. Sighting Expedients.

(1). *For Direct Aiming.*—When the target is visible and on much the same level as the firer, the dial sight pointer of the rifle can be used as a rough sight. If the "index point of pointer" be adjusted to the ranges given in the following table, and *aim be taken along the*

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arm of the pointer at the target, the rifle will be elevated approximately at the angles shown :—

Range on Dial Sight Plate.	Angle of Elevation of Rifle.
2,500 yards	30 degrees
2,550	40 ,,
2,600	50 ,,
2,650	60 ,,
2,700	70 ,,

(2). *For Indirect Aiming.*—A clinometer is improvised on the rifle as follows:—The dial sight pointer is placed at right angles to the axis of the barrel, with the " bead pointer " upwards. A piece of string about 6 in. long has one end tied to this bead, any small weight attached to the other, and allowed to hang vertically down. The rifle is now inclined successively at the various angles of elevation given in the range table (*vide* para. VI.), which is easily done by aid of the Abney's level carried in the equipment of a field company of S. & M. The wood of the fore-end of the rifle is then marked with a knife, or with paint, where the above improvised plumb-line crosses it at each elevation. Once this has been done, any required elevation is obtained by elevating the rifle till the plumb-line again touches the required mark. This is the most suitable arrangement if the rifle is to be fired from a fixed rest, *vide* para. IV. (*vide Photo*).

VIII. Use as a Hand Grenade.

It will be seen from para. VI. that for ranges of less than 50 yards, the grenade must be thrown by hand. When so thrown it can be used either with percussion or time fuze, certain modifications being necessary in either case.

(1). *Percussion Fuze Hand Grenade.*—To adapt the rifle grenade for this purpose it is necessary to remove and discard the bottom plug (*r*) with the tail rod (*a*), and substitute the " Handle " (*z*), *Fig.* 10. This is made of any light wood, and is quite sufficiently secured to the tube by two of the screws MM. Attached to this handle with tacks or twine is a calico " tail," 18 in. to 2 ft. long and 6 in. wide, which serves to keep the grenade head first during flight.

The stop (*p*) is also removed, and the safety spring VWXYZ either set permanently in its *Fig.* 4 position or (better) removed altogether.

To throw the grenade, the tail is balled up in the throwing hand, which grasps it and the handle together, and the grenade cast overhand at an angle of 30 or 40 degrees, just as a stone would be thrown. It can be thrown about 40 yards by the ordinary unpractised man, and 50 by an expert.

(2). *Time Fuze Hand Grenade.*—In this case the striker plug (*k*), the safety pin (*f*), the stop (*p*), and the cartridge (*x*), are discarded

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altogether, while the safety spring VWXYZ is either set permanently open, or also removed. A piece of safety fuze of suitable length ($3\frac{1}{2}$ in. will burn for about 7 seconds) is fitted in the detonator (*y*), and the end led out through the hole in the plug (*h*) and the top of the tube.

All that now is necessary is the ignition of this end of fuze and the prompt hurling of the grenade. The handle (*z*) may be fitted as before, or the grenade may be thrown by the tail rod (*a*), as it is immaterial whether it falls on its head or not.

IX. Efficiency.

The weight of charge, and weight and nature of projectile given above are the outcome of a large number of experiments. As an example of the action of these grenades the following experiments may be quoted :—

A grenade was exploded in the centre of a circular paling of wood, whose sides were 6 ft. high, and made of planks 2 in. thick. Thirty-two holes were blown clean through the 2-in. teak by segments. In addition, there were 37 other hits by segments, or parts of segments, which did not amount to penetration, and 84 minor hits from pieces of tin, etc. Of the 63 planks on end which formed the paling, 10 alone were not touched.

X. Sensitiveness.

The following also are the result of experiments at Bangalore :—

1. *Rifle Grenade.*—A rifle grenade will explode on pitching in mud or water.

2. *Hand Grenade.*—After removal of the safety pin, a grenade will explode if dropped 2 ft. on its head on hard ground.

XI. Carriage in the Field.

The most convenient way of carrying the grenades in the field is in a " quiver " made of canvas, very much like a small golf bag, but with a flap over the mouth to retain the grenades and exclude the rain.

Six grenades are a suitable number for the quiver, whose dimensions are then as follows :—Length 2 ft., diameter at mouth 7 in., diameter at bottom 3 in. The bottom is closed with a piece of wood 3 in. in diameter and $1\frac{1}{2}$ in. thick, in whose upper surface is bored a hole 2 in. across and $1\frac{1}{4}$ in. deep. The six grenades stand head up in the quiver, and their six gas checks are placed in this hole, and so protected from accidental damage. There is room also in this quiver for the six handles (*z*) *vide* para. VIII., if required. The range

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table (*vide* para. VI.), can be conveniently inscribed on the under side of the flap, for reference in the field.

The whole, which weighs about 9 lbs. full, is slung over the right shoulder with a strap, and rests between the left arm and side (*vide Photo*).

XII. TIME, COST, AND LABOUR.

Table A is the result of actual experiments at Bangalore. It will be seen that the time and labour consumed in the manufacture of one of these grenades amounts to 4·8 man-hours.

The materials necessary for the construction of any number of grenades can be ascertained from the same Table. It should be remembered, however, that the various materials were usually chosen rather because they happened to be on hand in the S. & M. Workshops at Bangalore, than from any special suitability. Many other materials could be used, the dimensions of the grenade being varied, *mutatis mutandis*. For instance, if $\frac{3}{16}$-in. square iron rod is not available for projectile, a very slight increase of diameter in the grenade will allow pieces of $\frac{1}{4}$-in. round steel rod, such as is required for the tail rod (*a*), to be used instead.

From the same Table the cost is seen to be approximately Rs.1/8/0 per grenade, including labour and all material and explosives. The price quoted for the actual "Hale's Rifle Grenade" varies from 10s. to 17s. according to pattern.

My thanks are due to Regtl.-Sergt.-Major King, R.E., of the 2nd (Q.V.O.) S. & M., who has given me the greatest assistance in the whole of the experiments connected with the above grenade.

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TABLE A.—Details of Time and Cost of Manufacture of 24 Bangalore Improvised Grenades. Mark II. (Universal Pattern).

		Hours Work. 1 Man. 1st Rate.	No. or Quantity.	Rate. Rs.	A.	P.	Per.	Amount. Rs.	A.	P.
	1. *Tinsmiths' Work.*									
Labour.	Making Body Tubes and punching holes (*b*, M and *m*) ... ... ,, Wad Discs (*c*) ... ... ,, Safety Plates (*f*) and soldering to Safety Springs (VWXYZ) ,, Bottom Clips (FS) ... ... ,, Clutches (*q*) for Stops (*p*) ... ... ,, Gas-Check Discs (*v*) and Fixing to Gas Checks ... .. Fixing Gas Checks (*g*) to Tail Rods (*a*)	39	—	—	4	0	8 hours	1	4	0
Material.	Tin sheet medium 20 in. × 14 in., for the above ... . Solder do. ... . Fluxite and charcoal do.	— — —	4 sheets ½ lb. Inappreciable	— 1 —	6 3 —	3 0 —	sheet lb. say	1 — —	9 9 4	0 0 0
	2. *Smiths' Work.*									
Labour.	Cutting and Notching Segment Bars (*n*)... ... ... ,, Tail Rods (*a*); screwing for Nuts (T and *t*) and coning for Gas Checks (*g*) ... ... ,, Gas Checks from bullets and drilling for Tail Rods ...	27	—	—	4	0	8 hours	—	14	0
Material.	Iron Rod $\frac{3}{16}$ in. × $\frac{3}{16}$ in. for 528 Segment Bars (*n*) ... . Steel Rod ¼ in. round for 24 Tail Rods (*a*) ... . Nuts, iron, square, ½-in. side, for ¼-in. bolt (T and *t*) ... ... (For Bullets for Gas Checks, see § 4 infra).	— — —	16½ lbs. 7 lbs. 48	8 42 —	8 0 4	0 0 0	cwt. ,, doz.	1 2 1	3 10 0	6 0 0
	3. *Carpenters' Work.*									
Labour.	Making Plug Striker (*k*) ... ... ,, ,, Cartridge (*h*) ... ... ,, ,, Bottom (*r*) ... ... Fixing Strikers (*i*) in Striker Plug (*k*) ... ... ,, Tail Rods (*a*), Bottom Clips (FS) and Wad Discs (*c*) to Bottom Plugs (*r*) ... ... Assembling grenades and adjusting Safety Spring (VWXYZ), Stops (*p*), Retaining Wires (*e*) and Safety Pins (*f*)	42	—	—	4	0	8 hours	1	6	0

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TABLE A.—*Continued.*

		Hours Work. 1 Man. 1st Rate.	No. or Quantity.	Rate. Rs.	A.	P.	Per.	Amount. Rs.	A.	P.
	3. *Carpenters' Work —Continued.*									
Material.	Teak wood, for Plugs (*k*), (*h*) and (*r*)	—	¼ cubic foot	3	8	0	c. ft.	—	14	0
	Wire, Steel, S.W.G. 20 for Safety Spring (VWXYZ) and Stop (*p*) ...	—	¼ lb.	1	4	0	lb.	—	5	0
	,, Iron, Telegraph, 75 lbs. for Safety Pin (*f*)	—	Inappreciable	—	—	—	say	—	1	0
	,, Brass or Copper, S.W.G. 20, for retaining Wires, 8in. long each									
	Screws, Iron, ⅜ in. (Size No. 4) 192, for fixing Plugs (*k* and *r*) to Tube	—	1½ gross	—	6	6	gross	—	9	9
	,, ,, ⅝ in. (Size No. 7) 24, for Striker Points (*i*)... ...									
	4. *Loading.*									
	(Should be done by an officer, or other responsible person).									
Labour.	Inserting Cartridge Cases, (*x*) in Plugs (*k*)									
	,, Detonators (*y*) in Primers (*s*)									
	,, Filler (*d*) ,, ,, ,, ...	2	—	—	—	—	—	—	—	—
	,, Primers and Segments (*n*) in Tube									
	Fixing Bottom Plugs (*r*) in Tubes									
Material.	Cartridges, L.M. ·303 (*x*)	—	24	55	0	0	per 1,000	1	5	2
	[Bullets of these Cartridges make the Gas Checks (*g*)].									
	Detonators, Nobel's No. 8 (*y*)	—	24	9	0	6	per 100	2	2	8
	G.C. Dry Primers 1 oz. (*ss*)	—	48	—	6	0	each	18	0	0
	5. *Additional Fittings for Use as Hand Grenade.*									
	Carpenters' Work.									
Labour.	Making 24 wood handles (*s*)	6	—	—	4	0	8 hours	—	3	0
	Attaching calico tails									
Material.	Dealwood for Handles (*s*)	—	¼ cubic foot	3	0	0	c. ft.	—	12	0
	Calico 1 yard wide, for tails (18 in. long each and 6 in. wide) ...	—	2 yards	—	6	0	yard	—	12	0
	String, for attaching tails to Handles	—	Inappreciable	—	—	—	say	—	0	3
	Total for 24 Grenades ...	116 hours	... ...				... Rs.	35	12	4

Therefore a single grenade costs approximately Rs. 1/8/0, to make, including labour and explosives, and its manufacture takes 4·8 man-hours.

NOTE.—The above Table is for the manufacture of the *Universal* grenade, convertible for use either as *Rifle* grenade or *Hand* grenade. Should the former only be required, then the operations of §5 would be entirely omitted. If the latter only, then the manufacture of the following parts would be altogether dispensed with :—(*a*), (*b*), (*c*), (*g*), (*j*), (*p*), (*r*), (*u*), (*v*), (T & *t*), (FS), (VWXYZ), and half the Screws (M & *m*)—to the considerable economy of time and material.

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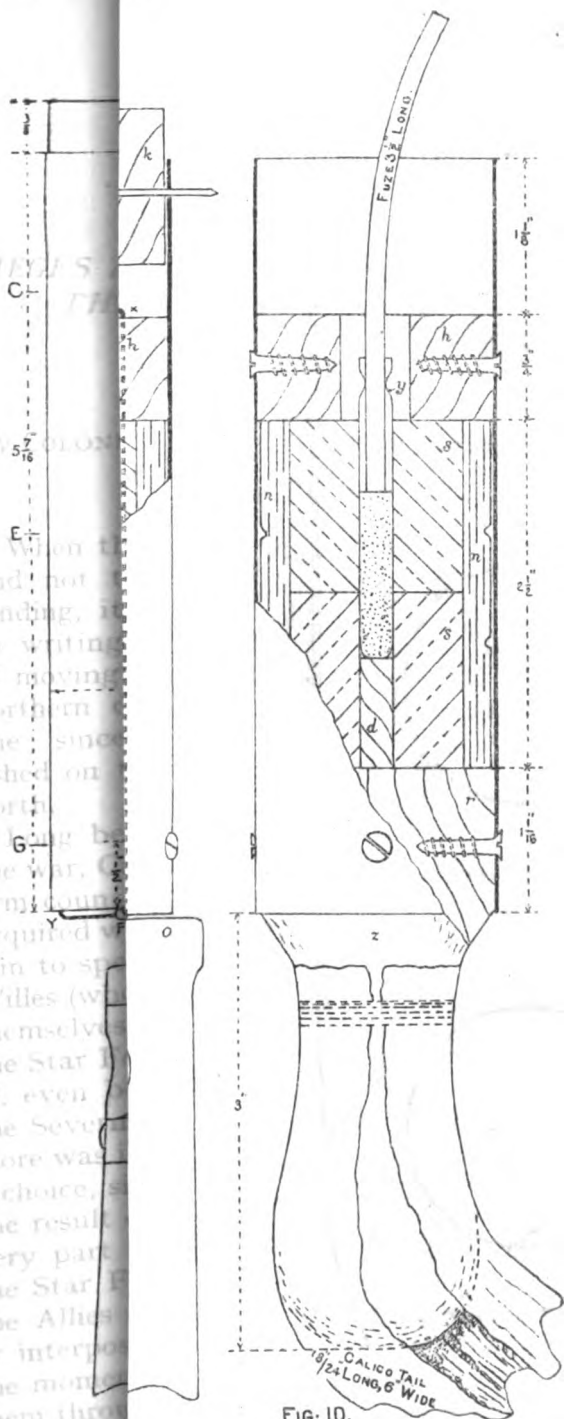

FIG: 10.

N: ON O P. HAND GRENADE (TIME FUZE)

a Tail Rod.
b Safety Port.
c Tin Wad Discs.
d Wooden Filler.
e Retaining W[illegible]
r Gas Check Disc.
rr Safety Spring (in section),
Z ,, in elevation, and plan.
x Cartridge Case.
y Detonator.
z Handle.
FS Lugs on Tin Clip.

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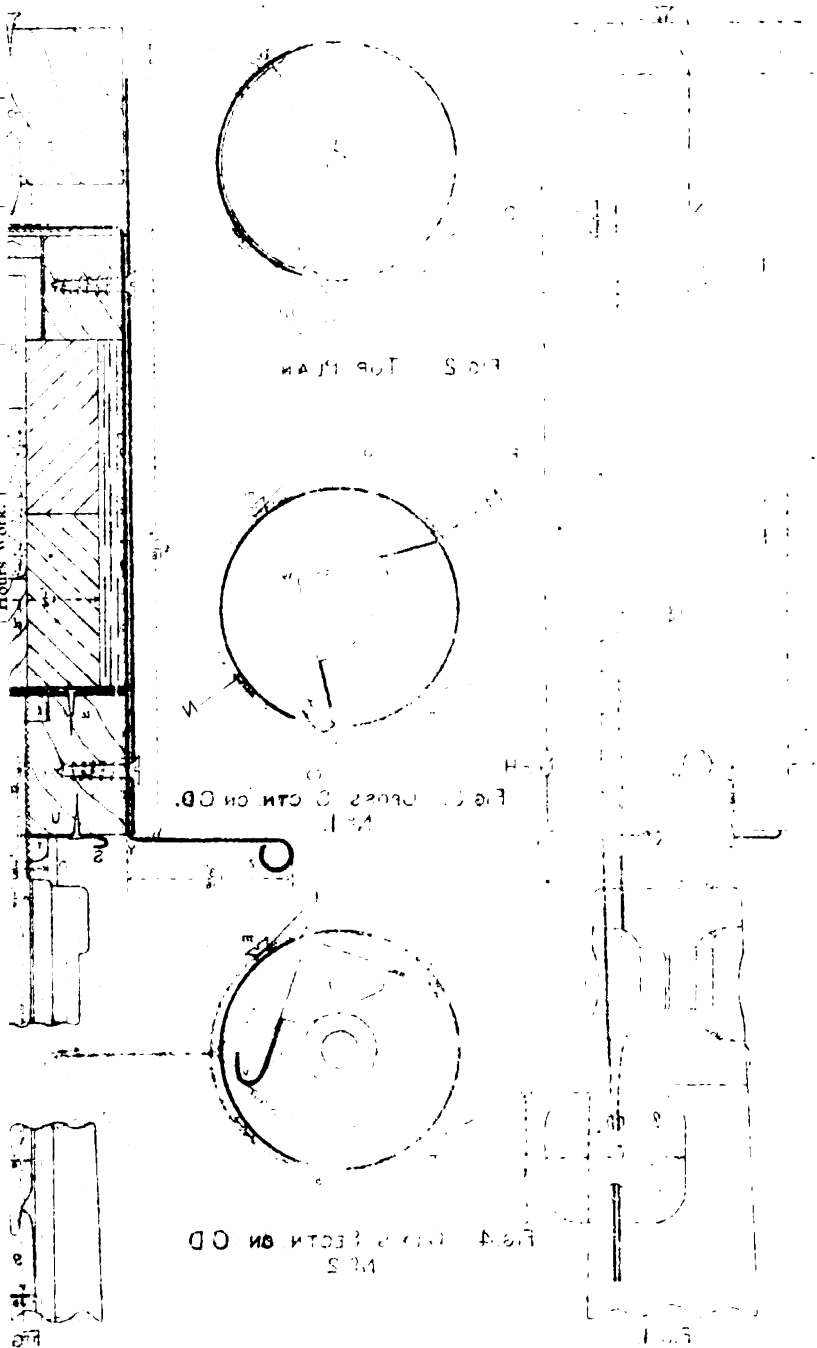
TABLE A.—*Continued.*



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SIEGES AND THE DEFENCE OF FORTIFIED PLACES BY THE BRITISH AND INDIAN ARMIES IN THE XIXth CENTURY.

(*Continued*).

By COLONEL SIR EDWARD T. THACKERAY, V.C., K.C.B. (LATE R.E.).

THE GREAT SIEGE OF SEBASTOPOL, 1854–55.

When the Allies in Bulgaria finally determined upon the western and not the southern coast of the Crimea as the place of their landing, it was taken for granted, though not perhaps committed to writing, that this resolve carried with it the ulterior design of moving southward along the coast, and operating against the northern defences of Sebastopol. The assumption was a natural one; since Sebastopol Bay made it impossible for an invader established on the western side to attempt an attack, except from the north.

Long before, and prior indeed to the actual commencement of the war, Capt. Drummond, of the *Retribution*, had ventured to give firm counsel upon this subject; and the knowledge which he had acquired while lying at anchor in the roadstead of Sebastopol enabled him to speak with great weight. Both Capt. Drummond and Capt. Willes (who was acting with him at the time of the survey) conceived themselves able to report decisively in favour of an attack upon the Star Fort as a means of achieving the great object of the Allies. If, even before the invasion they were warranted in fixing upon the Severnaya or "North Side" as the true point of attack, much more was it now, September, 1854, to be concluded in favour of such a choice, since the Allies by their successful landing, followed up by the result of the battle of the Alma, had fastened already on that very part of the coast from which they could conveniently assail the Star Fort; and moreover it was fairly to be reckoned, that if the Allies should go straight to their end, without turning aside or interposing fresh marches between themselves and the enemy, the momentum they had gathered from their victory might carry them through the defences without necessitating a siege.

Bivouacking now on the Belbec, the Allies were at last within gunshot of the fortress they had come over sea to confront; and

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the period during which it had been possible to keep the question open being close to its end, they were called upon to determine whether they would at once prepare to deliver the attack, or give up their old plan of campaign.

On the northern side of Sebastopol Bay, and facing the sea forts which covered the town and harbour, there were not only other sea forts of great size and power but also some barracks, some magazines, and a factory worked by the Government. This aggregate of buildings, or the quarter on which they stood, was known amongst Russians by the name of the Severnaya and by the English as the "North Side."

The sea forts were not so constructed as to be the means of defence against an invader coming down upon them by land from the north; but on the high ground above, though still at a distance of only a few hundred yards from the bay, there was a dilapidated work, called by the English the Star Fort, which had been constructed in 1818. It was of octagonal shape with sides from 190 to 230 yards long; and of its eight angles, every other one was supplied with a little bastion or caponière having an earthen parapet, whilst three out of the four remaining angles of the octagon were furnished with small bonnettes or barbettes, each taking three guns. The profiles of the bastion were 14 ft. high and 10 ft. thick. The bastion which looked towards the roadstead was retrenched at its gorge by a cavalier. The fort was surrounded by a ditch 12 ft. deep and 18 ft. broad with revetment in masonry and a glacis.

Of the 47 guns with which the work was armed only 12 could be of service in the expected attack from the north. The fort was commanded and even looked into from the heights towards the north. In and near this work, from the day of the landing on the 14th of September, down to the evening of the 24th, the Russians had toiled night and day, at one time with a force of 1,500 workmen. Their object was not only to repair and strengthen the Star Fort itself, but also to provide generally for the defence of the plateau against an enemy advancing from the Belbec. By those who knew that these hurried works went on under the direction of Colonel Todleben it will be easily inferred that they were planned with a consummate skill; but what even he found means to achieve in ten days could not but fall very short of what was needed. One of Todleben's objects was to throw up works which might prevent the enemy from turning the Star Fort on the eastern flank, but for the execution of this part of his plan there was no time.

By the morning of the 25th there were altogether twenty-nine guns in battery and available for the defence against the expected attack from the north. The two north-western batteries were however liable to be destroyed by the guns of the Anglo-French

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fleet ; * and the trench connecting one of them with the fort could be enfiladed and taken in rear by the fire from the same quarter.† Indeed the position of the ground and of the Russian works was such that in every stage of an attack undertaken against the Star Fort, the seamen and the ships of the Allies would be able to take a great part.‡

In order to cover the retreat of the Russians, some of their ships were placed in such positions as to be able to sweep with their broadsides the slopes on the north of the roadstead. The form of the ravines descending from the Star Fort was such that upon two if not upon three, of the approaches from the side of the Belbec, the assailants might come up to the ditch without first incurring a cannonade of any great force or duration.

With regard to the forces available for the defence, it may be said that if the Allies had advanced against the Star Fort on the morning of the 25th they would have encountered there and on the ground adjoining a battalion of militiamen, a company of sappers and so large a body of sailors—withdrawn for that purpose from the ships and from the defence of the South Side—as would bring up the whole number to 11,000.§ The sailors were for the most part, badly armed, some of them having old flint and steel muskets, and others, it seems, only pikes and cutlasses. This was the force which extended along a front of a mile, was to defend the fort and the plateau against a victorious army of from 50,000 to 60,000 men, supported and actively aided by their fleets. The defenders were, however, commanded by one whose name will be long illustrious in the annals of Russia. For the present it suffices to say of Admiral Korniloff that he was a chivalrous, resolute and devoted seaman who, with hardly any hope of any better success than that of an honourable death, had determined to defend the plateau and the fort to the last extremity.

The officer who planned and directed the works of defence was Colonel Todleben and he was of opinion that the plateau and the fort could not have been successfully defended against the attack which the Allies had the means of making. The situation of the defenders, he says, notwithstanding all they had done, and notwithstanding their heroic resolves was nothing less than desperate ; ‖ and he declared that the complete success of the expected attack by the Allies would have been inevitable. Lord Raglan and Sir Edmund Lyons came in fact to the same conclusion as Colonel Todleben, and it is not possible in this short account of the

* Todleben, *Defense de Sebastopol*, Vol. I., p. 233.
† Ibid.
‡ Ibid.
§ Todleben 11,350.—*Defense de Sebastopol*, Vol. I., p. 227.
‖ *Defense de Sebastopol*, Vol. I., p. 230–33.

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memorable siege to discuss the reasons for the Allies relinquishing the proposed attack on the North Side.

The Allies were not ignorant that the possession of the North Side would at once enable them to cannonade the enemy's shipping. Nor again did they fall into the error of supposing the Star Fort of itself to be a formidable work. By far the gravest of the obstacles to the plan of assailing the North Side was the want of a safe harbour on that part of the neighbouring coast which was north of the Sebastopol Bay. It was said that the attack might take time, and that pending the operations, the fleets might be so driven from the coast by stress of weather as to put the Allies in peril for their supplies.

So inextricably were the Allies engaged in the expedition, and so deeply were they committed in the face of Europe to the duty of achieving their end, that whatever might have been their wisdom originally in resolving to touch the Crimea, ordinary prudence now seemed to command that they should follow up the victory with swiftness, and always in that venturesome temper which was the only one fitted for their enterprise. For refuge as well as for glory they needed the port of Sebastopol. But if the relinquishment of the North Side was not to be justified on military grounds, there was still this to be said for the measure; it was a way out of the trouble.

On the day after the battle of the Alma Lord Raglan proposed to Marshal St. Arnaud, the Commander-in-Chief of the French Army, "at once to advance to the Belbec, cross that river, and then assault the forts." The Marshal answered that "his troops were tired and that it could not be done."* It must also be added that the further efforts of Sir Edmund Lyons to induce the Marshal to agree to an attack on the position of the Star Fort met with no success.

Notwithstanding the failure of these efforts, Lord Raglan was thoroughly qualified to deal with the emergency in which the Allies would find themselves placed if the French should persist, as they did, in their unwillingness to assail the Star Fort.

At the time of the earliest deliberations on the subject, Lord Raglan had been disposed to think that Sebastopol ought to be attacked on the south; and although he had ceased to dwell upon the idea from the time when the west coast was chosen for the place of landing, it recurred to him on the morrow of the Battle of the Alma when he found himself encountered at the French head-quarters by a refusal to attack the Star Fort. He then conceived that if the French should persist to the last in their refusal, he at least might avert that utter cessation and collapse of the whole enterprise which their determination threatened to produce by

* Statement of Sir E. Lyons.

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persuading them (as a substitute for the old plan which they were then abandoning) to join with him in marching across the country to the south coast, and there establishing a new base of operations, from which to attack Sebastopol on its south side.

The unwillingness of the French to attack the north side of Sebastopol had brought the Allies into straits so hard, that with all its rashness the plan of defiling round the east of Sebastopol might be regarded as the least of the evils from which a choice could be made. Rightly looked at "the flank march," for so the movement is called, was a perilous, a desperate expedient, by which Lord Raglan sought to find an alternative for the enterprise declined by the French and avert a collapse of the whole undertaking.

From causes which will be spoken of later, the French Army, without any fault of its own was, for the moment, paralyzed; and the English Army, on the other hand, being ready for action and under a General resolved to force on the enterprise, there was a great temptation to clutch at a plan which would relieve the French Army from all immediate demands on its energies, and cast the load on the English. The plan of the flank march fulfilled these conditions; for it spared the French from the task which seemed to await them on their right front, and invested the English General with the leadership, and the virtual control of the proposed operation.

But although it was as an escape from a dilemma that the flank march is best to be justified, it is not believed that Lord Raglan himself thought ill of the measure. Without ever wavering in his opinion that the victory on the Alma should be followed up by pursuing the old plan, and attacking the Severnaya or north fort, he yet thought that he saw such good features in the alternative plan as to be able to fall back upon it with contentment. Apparently he was not much impressed with the hazardous character of the flank march; and on the other hand he certainly thought that, if once the Allies should be established on the south coast, they would then be on the best ground for attacking Sebastopol.

For the purpose of informing himself upon any question of military engineering, Lord Raglan had at his side an accomplished and gifted adviser. Sir John Burgoyne was a general of Engineers now serving on the Staff of the Army which Lord Raglan commanded. His experience of war was very great. It began with the first year of the century at Malta. In 1806 he was serving in Sicily. He was Commanding Engineer with General Fraser's expedition to Egypt, and was at the assault on the lines of Alexandria, and the Siege of Rosetta. He was with Sir John Moore at Messina and in Sweden in 1808, and was with him the same year in the Peninsular. He was at Corunna. He blew up the bridge of Benevente in the presence

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of the enemy. He was with Sir Arthur Wellesley in 1809, and at the passage of the Douro. He served in the lines of Torres Vedras. He blew up Fort Conception in presence of the enemy. He was at Busaco, at the first siege of Badajoz, at Elboden, and at the siege and capture of Ciudad Rodrigo. He was at the second siege and capture of Badajoz, and was present at the assault and escalade of the castle. He was Commanding Engineer at the siege and capture of the Forts of Salamanca and at the battle. He was Commanding Engineer at the capture of Madrid, and the Retiro, and also at the siege of Burgos where he was wounded. At Vittoria he had a horse shot under him. He was wounded at the assault of San Sebastian where he conducted the siege as Commanding Engineer. He was also at New Orleans. He had therefore a vast experience, connecting his name with a glorious period of English history; and the value of this advantage was not, as often happens in the least counteracted by failure of energy. As might be expected he was a master of military engineering science; but his mind ranging freely beyond his own branch of the service, had become stored with the many kinds of knowledge which concern the whole business of war. Of course it might have been thought that the judgment of a man deeply versed in the business of sieges should be more or less warped by his science; but Sir John Burgoyne had so much breadth of view, and so general a knowledge of war that he was little likely to err in that direction.

Sir John Burgoyne held strongly that the project of an attack upon the south side of Sebastopol had many and great advantages, and also that the Star Fort was far too strong to be carried by a *coup de main*.

Before the battle of the Alma, Lord Raglan requested Sir John to put his opinion in writing; and, in the course of the same day, the English Commander was furnished with this memorandum:—

"CAMP ON THE ALMA, 21ST *September*, 1854.

"I would submit that unless some impending circumstances occur which cannot now be foreseen, the combined armies should at once move round to the south side of Sebastopol, instead of attacking Fort Constantine; by which the following advantages may be anticipated:—

"1. That instead of attacking a position naturally strong and of limited extent to which a powerful support will be given by Fort Constantine, which is a permanent fortification, though by no means formidable if, insulated, the enemy would have to defend a very extensive line, divided by valleys, and, from every information, very imperfectly, if at all entrenched, and which would probably be forced rapidly.

"2. As the advance is from the north, our attack will rather be expected on that side, and not on the south.

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"3. Even supposing Fort Constantine* to be taken, although it will open the shipping, dockyard, etc., to cannonading, it will not ensure entire possession of the important establishments until after a second operation, which may still require to move round to the south, while the enemy will retain free and open communication to the place.

"4. There is every reason to believe from the appearance of the maps, and what may be expected to be the formation of the ground, that there is a very strong position between the sea at Balaclava, and along the valley of the Tchernaya, that would most efficiently cover the Allied Armies during the operation, but which is too extensive to be taken up by the garrison.

"5. That the communication with the fleet, which is, in fact, our base of operations, would be much more secure and commodious by the small harbour of Balaclava, and the bays near Chersonese, than on the open coast to the north, and with the advantage of a good road to the attacks, and a very flat country to pass to them from the bays near Chersonese.

"6. Under ordinary circumstances such a movement would have the effect of exposing the communication of the army to be cut off; but in this case the idea is to abandon the communication from the north altogether, and establish a new one to the shipping in the south which would be moved round for that purpose.

"J. F. BURGOYNE, *Lieut.-General.*"

Sir John Burgoyne, by Lord Raglan's direction, then propounded the flank march to Marshal St. Arnaud, and Lord Raglan himself held a conference with the Marshal on the evening of the 24th; Marshal St. Arnaud it seems, though not without some hesitation, had already made up his mind to accept it. On this subject, therefore, neither one nor the other of the two commanders had need to use words of persuasion. They agreed to attempt the flank march.

At the time of this conference, Marshal St. Arnaud was in a dying state although he forced himself to sit rigidly up in an armchair, and on the night between the 26th and 27th September he ceased to hold his command and made over his trying and important duties to General Canrobert, a general with a brilliant reputation established in African warfare.

On this night the Marshal had thrown off the cholera, but other ailments still caused from time to time cruel suffering alternating with periods of prostration. From the moment he resigned the command he longed with great intensity to leave the Crimea, but before he embarked Lord Raglan went to his bedside to bid him adieu.

Almost the last of the Marshal's acts whilst on shore gave proof

* By Fort Constantine Sir John Burgoyne probably meant the Star Fort. Fort Constantine was one of the sea forts, but at this period of the invasion the name was often applied by mistake to the Star Fort.

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of that freedom from vindictiveness which was one of the features of his character. Before he embarked he offered a present—his Russian carriage and horses—to General Bosquet, an officer of great repute in the French Army who even at that parting moment was regarded by the Marshal as his enemy. Covered by a tricolour flag, he was carried on board ship by the seamen of the *Berthollet* on the 29th September, and placed in the cabin prepared for him. This was in the morning, and although he no longer suffered pain, between noon and sunset he died.

During the seven days after the Battle of the Alma which were passed by the Allies in caring for their wounded and in marching to the southern coast of the peninsular, men faithful to their Czar and their country, and so endued with courage as to be able to exert their whole power of mind and body under a weight of disasters which seemed hardly short of mere ruin, were entering upon a task of great moment, and destined to be famous in history. Expecting the attack of a victorious host, and abandoned by their own defeated army, an admiral* with some thousands of sailors and workmen, all guided by the skilled engineer† whose achievement has made him illustrious, were preparing the defence of Sebastopol.

Towards the south-western extremity of the Crimea there is an arm of the sea, with a breadth of from 1,000 to 1,500 yards which stretches in from the west to a distance of 3½ miles. This deep narrow bay is the roadstead of Sebastopol. On the north the roadstead is bounded by the slopes and ledges on which stand the forts and buildings constituting the Severnaya or "North Side of Sebastopol." There was reason for believing that even so late as the 25th September, though much had been done since the day of the landing, the Star Fort, the key of the North Side, could not have been successfully defended against a resolute attack by the Allies.

The plateau on the south and south-west of the bay is heart-shaped and is called the Chersonese. Its eastern end is much higher than the western and on this—the landward—side, it is abruptly divided from the plain by an acclivity rising from a height of from 500 ft. to about 700 ft., and extending for a distance of about 8 miles from north to south (in a straight line) so as to form a continuous buttress to the plain. This acclivity as well as the easternmost crest of the table-land or plateau at its top, is called Mount Sapounè.

The only great break in the steepness thus dividing the table-land of the Chersonese from the plain is at the point some 3 miles from the southern coast called the "Col de Balaklava." Along a distance of about 4 miles in a straight line, beginning from its north-easterly angle near the Inkerman bridge and going thence westerly, the

* Admiral Korniloff.
† General de Todleben.

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plateau is washed for the first half-mile by the Tchernaya, and lower down by the waters of the Sebastopol bay; but the rest of the water boundary is the open sea. The side of the Chersonese which lies towards the north is deeply jagged by creeks or bays throughout its whole length, from the Inkerman bridge on the east to Cape Chersonese on the west; but on the south and south-western side of the plateau its shore line has a different character and it is only after passing the plateau that an inlet can be found. This inlet is called the Port of Balaklava. The length of the plateau from its easternmost side to Cape Chersonese is about 10 miles.

Throughout its extent the plateau is scarred by ravines. Some of these are deep and precipitous. They run, for the most part in a direction from the south-east to the north-west, and several of them are prolongations of the openings which form the many creeks and bays indenting the north and north-west of the plateau.

Of these creeks there is one which stretching deep in from the roadstead from north to south had become the port of Sebastopol or as the English used to call it the "Man-of-War Harbour." In this port mighty fleets could be sheltered.

Including the eastern suburb which is called the Karabel Faubourg, Sebastopol may be regarded as standing upon a semi-circular tract of ground, subtended by the great bay or roadstead, and split into two segments by the "Man-of-War Harbour" in such a manner that the western segment included Sebastopol proper, with the Admiralty, the public buildings, the arsenal, and town; whilst the eastern segment—that is the Karabel Faubourg—contained among other buildings, the docks, great Government store-houses, some barracks on a large scale, and a church.

The separation of the town from its faubourg was rendered more complete by the steepness and depth of the ravine which descended into the Man-of-War Harbour. The configuration of land and water which thus split off the faubourg from the main town was a great source of embarrassment to the defenders, and was not the only obstacle in the way of their lateral communications, for there was another ravine which subdivided the town, and another again which cut the suburb in two. These ravines as well as the ridges and knolls on which the place stood, sloped down with more or less abruptness to the water's edge. The long hill on which the main part of the town stood, is 200 ft. above the level of the sea.

Of the streets in the town two were spacious, and in these stood the principal buildings. The rest of the streets were narrow. On the highest spot in the town stood the Naval Library, and on the top of the building was an observatory.

In the times immediately preceding the invasion the numbers

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collected within the town and its suburbs had been in general about 42,000, but 35,000 of these belonged to the fleet or the army.

At the time of the invasion, the entrances both north and south of the great bay or roadstead, and both its shores within, to a distance of more than 2 miles, were studded with fortified works. Of these, some indeed, were only great earthworks, but others, and those the chief ones, were huge casemated forts, having stone-work revetments. These sea forts and batteries were—On the north side, Fort Constantine and Fort Michael, both stoneworks, the work called "Number Four," the "Twelve Apostles" and "Paris"; and on the south side the Quarantine Sea Fort, Fort Alexander, the Artillery Fort, Fort Nicholas, and Fort Paul, and lastly the Sviatoslaw Battery. It was to cover Fort Constantine on its landward side, and to prevent the enemy's ships from approaching the shore, that after the breaking out of the war, the Volokhoff Tower (surnamed by our people the "Wasp") and the Telegraph Battery were erected on the high ground between the Star Fort and the open sea. In all these forts and batteries, without including the Star Fort, there were mounted at the time of the landing 611 guns for the most part of heavy calibre.

The Black Sea Fleet, which lay in the harbour or in the roadstead, consisted of 14 line-of-battle ships, 7 frigates, 1 corvette, 2 brigs, and 11 war steamers besides some other vessels. It carried 1,908 guns, and was manned by 18,500 seamen. There was a boom across the roadstead, at some distance from its entrance. Before the day of the Alma, it was believed by the Russians that these defences alone were quite sufficient to secure the roadstead against an attack from the sea; and after the sinking of the ships at the mouth of the bay, the Allies acquiesced in this judgment, abstaining throughout the war from any attempt to break in with their fleets. On the eastern side also the Karabel suburb was so bounded by the Careening Bay, and the deep ravine at its head, that in that quarter also, the dominion of the water by the Russians was an obstacle to any attack. Thus relieved from apprehension of attack from the side of the water, the garrison would be able to bring almost their whole strength to bear upon the land defences. On the western side of Sebastopol there was a wide and deep ravine, running parallel with the boundary of the place which could not but be a grave obstacle to besiegers; and upon the whole the configuration of the ground was such that works on a moderate scale might suffice to prevent an enemy from choosing his point of attack in that direction.

It was towards the south and south-east that the defenders were least helped by nature. Even in these quarters, however, the configuration of the ground was in some respects favourable to the defence; for the ravines descended into the place in a way which

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laid them open to the fire of the garrison, especially to fire from the ships; and everyone of the intervening ridges along which the assailants could best push their attacks was so formed by nature as to offer the defenders an advantageous position for the erection of a fortified work.

Other sources of embarrassment existed which, however—though not in an equal degree—were common to the attack and the defence. Besiegers and besieged alike were sure to be put to great stress by the depth of the ravines, which would more or less split their strength by hampering all lateral movements; and in event of the conflict taking a form which should make it depend much upon earthworks, both the garrison and their assailants would have to encounter the difficulty of trying to gain cover from ground which was simply hard rock, coated over, where coated at all, with a very thin layer of clay.

The length of the semi-circular line which had to be defended throughout was 4 miles; and of the defensive posts which might be most advantageously established along this extended line, there were three at the least, so circumstanced that the loss of any one of them would be likely to carry with it the fall of the place.*

Although in the beginning of February, 1854, the works planned for the defence of the west side of the town had been begun, the whole of the Karabel suburb, and even the approach from the south leading into the heart of the place, remained untouched by the spade. After that period, however some works sprang up; and on the day when the Allies effected their landing, the state of the land defences was as follows:—At intervals along a curved line beginning from the Artillery Fort, and ending at the ground overhanging the Man-of-War Harbour, there now stood this chain of works: the Artillery Fort, the Land Quarantine Bastion, the Central Bastion, the Schwartz Redoubt, and the Flagstaff Bastion.

With the exception of the Central Bastion, which was still in course of construction, these works had been completed, and were connected with one another by a loopholed wall, which passed, with but little interruption, along the whole of the curved line from the Artillery Fort to the head of the Man-of-War Harbour. Besides these works, the isolated sea fort near Quarantine Bay, and also the Artillery Fort, had been so closed by earthworks at their gorges as to be turned into redoubts, now defended on the land side as well as on the side of the water.

In the Karabel suburb less had been done; but there also, along a curved line extending from the head of the Man-of-War Harbour

* The position subsequently occupied by the Malakoff, the Redan, and the Flagstaff Bastion. Todleben even says that the loss of the "Central," or of the "Land Quarantine" Bastion would also have been fatal.

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to the mouth of the Careening Bay, were already the Redan, the Malakoff Tower, the Little Redan, and finally a single-faced battery for four guns in connection with the stone building in the form of a cross, which stood near the Careening Bay. The works thus defending the Karabel Faubourg were not as yet connected by any intermediate entrenchment; and the Malakoff, afterwards so formidable, was at this time only a naked horseshoe-shaped tower having five guns at the top, but without the glacis, which were soon afterwards added. At this time the number of guns for the defence of the south side of Sebastopol on its land side amounted to 151. Of these 128 pieces were applied to the defence of Sebastopol proper, and only 23 to that of the Karabel suburb.

The strength of the Czar's forces in the Crimea, according to General de Todleben on the day when the great armada of the Allies was seen to be approaching the coast, may be taken to stand as follows :— The land forces then occupying the peninsular were 54,000 strong.* Of this force, some small portions consisting of about 1,000 men, were local troops; and another portion to the number of 2,700, was a body of artillerymen permanently stationed at the batteries of the coast defences; but the rest, amounting in numbers to more than 50,500, were troops belonging to what the Russians called their "active army" and were available for operations in the field wherever their services might be needed. Of these Prince Mentschikoff had under his immediate personal command a force of 38,500 men. These lay posted partly in Sebastopol and partly at other places, but all were so nearly in hand as to be capable of being assembled in time for the battle. The rest of the regular land forces in the Crimea amounted in number to about 12,000 and were stationed under the command of General Khoumatoff in the south-eastern part of the peninsular; but even these most distant troops were not so far beyond reach as to make it impossible to call them in to headquarters before the critical moment.†

Besides these bodies of men, which were all land forces proper, there were some bodies of marines which had been permanently stationed partly at the several sections into which the land defences had been divided, and partly in furnishing guards for the Admiralty and the hospital. They amounted in number to 2,600. There were besides four "landing battalions" amounting in number to 1,800 men who were posted along the lines of defence.

* 54,208 thus made up :—

Strength of the army (Todleben)	..	51,500
Artillery appropriated to the coast defences	..	2,708
		54,208

† This was proved by the forced march of the Moscow Regiment which having been ordered up soon after the appearance of the Allies on the coast was on the field of the Alma on the morning of the battle.

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The seamen of the Black Sea Fleet lying in the harbour numbered 18,500 men. Prince Mentschikoff, as High Admiral was in command of the fleet as well as the army, and in the absence of the Prince, Vice-Admiral Korniloff commanded the naval forces and the roadstead, and the harbour of Sebastopol. The number of workmen whose services could be obtained for the defence of the place amounted to 5,000. Including these the force which Prince Mentschikoff had in the Crimea at the time of the landing therefore was 76,000 men.*

There were thousands of guns of heavy calibre in the arsenal but it was stated that owing to age and other causes, a large proportion of these were useless. Cranes, guns, and engines of all kinds were at the disposal of the defenders, and a body of men, 26,000 in number, who had long been accustomed to work them. There was an abundance of ammunition for all the early necessities of the defence and fresh supplies could always be poured in owing to it not being possible for the Allies to invest the place. At the early period of the siege the Russians squandered their ammunition.

At this time the five thousand workmen at the command of Prince Mentschikoff were busily employed, and the works on the north side especially were pushed on with ceaseless energy; but it was not until a week after the landing that these approached completion. On the south side the defenders were busied with a fieldwork connecting the Flag Staff and the Central Bastions. Means were also taken for perfecting the telegraphic communication between Sebastopol and the covering army.

When Prince Mentschikoff had advanced to the heights on the Alma with the whole of the forces which afterwards opposed our landing the number of men still forming the garrison of Sebastopol or aiding in its labours amounted to some 32,000. Of these, however, only the gunners at the coast defences, and the militia could be said to form part of the army.

Such was the condition of things at Sebastopol when on the 20th September, the telegraph announced to the garrison that the Allies were advancing to assail Prince Mentschikoff in his position on the Alma Heights.

The result of this great battle and the victory of the Allies is well known, and as we are only dealing with condensed accounts of sieges proper no attempt has been made to describe the great battles of

* 76,375 thus made up:—

The Army	51,500
Local companies	1,000
Stationed Marines	2,666
Seamen of the Black Sea Fleet	18,501
Artillerymen appropriated to the coast defences ..	2,708
	76,375

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Alma, Balaklava, and Inkerman. For full and detailed descriptions of these battles the reader is referred to the grand classical work, *The Invasion of the Crimea*, Vols. II., III., IV., and V., by the great military historian, A. W. Kinglake, from which work a large portion of this chapter has, by the kind permission of Messrs. Blackwood & Son, been taken.

Admiral Korniloff who was riding with Colonel Todleben towards the sound of the guns, was forced to apprehend, and then to see only too plainly the result of the encounter. "As I approached," he says, "the firing grew slacker, and I soon perceived that our army was retreating, but retreating in order. A sad picture it certainly was but the will of the Lord is inscrutable to us."

The next morning, Korniloff assembled a council of admirals and captains to determine what should be done in the straits to which things were brought by the loss of the battle. Prince Mentschikoff was not present at this council. Korniloff addressed the assembled admirals and captains. "Our army," he said, "is falling back on Sebastopol, and therefore the enemy will easily occupy the heights on the south of the Belbec. He will extend his forces as far as Inkerman* and Holland†, and commanding from those heights the ships of Nachimoff's squadron, he will force the fleet to leave its present position. By thus altering our order of battle for the fleet, he will make it feasible to force the entrance to the roadstead; and if at the same time his land forces should take the Star Fort, no resistance on our part, however heroic, will save the Black Sea Fleet from ruin and disgraceful capture. I therefore propose to put to sea and attack the enemy, crowded as he is off Cape Loukoul. I think that, fortune favouring us, we might disperse the enemy's armada, and thus deprive the Allied Armies of supplies and reinforcements. In the event of failure, we shall be able to avoid a disgraceful capture; for supposing we do not succeed in boarding the enemy's ships, we can at all events blow them up when close alongside, together with our own. Without the co-operation of the fleet, the Allied Armies could not capture the town, if fortified and defended by our troops, until the arrival of a fresh army from Russia, and then with united exertions we might crush the enemy."

The assembled admirals and captains received the proposal of Korniloff in blank silence, and although there were some who assented, the rest disapproved of it. All probably knew beforehand that the other measure was to be proposed, and that it had the sanction of Prince Mentschikoff, the Commander-in-Chief.

The rejection of Korniloff's measure was followed by the open

* This does not mean the ground where the Battle of Inkerman was fought but the eastern heights overhanging the head of the roadstead.

† The ground thus designated was between the Star Fort and the head of the roadstead.

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proposal of that other and very different line of action which was already engaging the thoughts of the council.

That which Capt. Zorin proposed was this: to sink some of the oldest ships across the mouth of the roadstead, and employ the crews of the sunken ships, as well as those of the rest of the fleet in reinforcing the garrison.

Korniloff expressed his dissent from the counter-proposal, but perceiving that the majority of the officers present approved it, and still holding to his own opinion, he dismissed the council, and with these words "Prepare for putting to sea. A signal will be given pointing out what everyone has to do."

But he spoke, the narrator said, with a heavy heart, for he had little hope that the Commander-in-Chief would change the resolve he had imparted to him the evening before. Korniloff however went to Prince Mentschikoff, and declared his intention of putting to sea. To this the Prince peremptorily objected, and he reiterated the order he had given to Korniloff the evening before—the order to close the roadstead by sinking some of the ships. Korniloff when told that he might return to his post at Nicolayaff, however said "It is suicide what you are compelling me to; but now—to leave Sebastopol surrounded by the enemy is impossible. I am ready to obey you."

Prince Mentschikoff was at this time very secret in regard to his ulterior plan for the disposition of the army; but for the present he allowed his troops to continue the movement which divided them from the field of the Alma, and retreat fairly into Sebastopol.

In a weakened and tired condition of body, but not, it is said, in a state of dejection, the troops in the course of the 21st September were all brought over the water, and into the town. Thence they were moved to a piece of ground outside which was called the Koolikoff Field. There they bivouacked. At 4 o'clock in the afternoon, the ships of the fleet including those that were doomed, began to move into their places, and at half-past ten at night all were in their ordered places. In the night the orders for the scuttling of the ships were obeyed, and at the dawn of the morning of the 23rd there were only to be seen some bare masts in the places where the *Siropol*, the *Varna*, and the *Silistria* had been lying the day before. Soon afterwards the *Oorgil* and the *Selaftroil* went down, and at 8 o'clock the *Flora* also disappeared, but the *Three Holy Fathers*, a 130-gun ship, was still erect. The commander of the steam frigate the *Thunder-Bearer* was commanded to fire into her sides, in order to "shorten her agony." At a quarter before one the sacred man-of-war reeled. For a moment—so pious men thought—the waves fell away recoiling, then closed, and bore the ship down.

But it must be acknowledged that the sinking of the ships was a

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wise measure. It fulfilled two great purposes. It not only closed the entrance of the roadstead against the Allies, but also, by putting a sure and visible end to the career of the fleet at sea, it brought to bear upon the land defences, that strength of 18,000 fit men, and those almost boundless resources in the way of materials which the Navy was able to furnish; Prince Mentschikoff's idea of at once shutting out the invading fleets, and turning his own navy into a town garrison by the short expedient of sinking some ships, was a conception boldly and ruthlessly formed, and one well adapted for its twofold end.

Of the celebrated flank march made by the Allied Armies in September it is not necessary to refer, as only the siege operations are being dealt with. It is sufficient to say that the march was successfully carried out without hindrance by the Russians, and that the town and port of Balaklava was seized and held.

In the course of the 25th Prince Mentschikoff with the whole of his force took up a position in the neighbourhood of Otarkoi; and the next day after leaving a detachment* in the country of the Upper Belbec, he yet further withdrew the main army, and completed his retreat to the Katcha.

There, day after day, he remained with his army, concerting no measures with the people he had left in Sebastopol for the defence or relief of the place, and suffering the garrison to live on for a time in ignorance of the region where he and his troops were reposing. So far from threatening or even observing the invaders, not only did he not know on which coast of the Crimea (the west or the south) they were operating, but when at last he once more put himself in communication with the garrison, it was to them that he looked for his tidings.

* A force of cavalry and infantry under Jabrokritzky amounting altogether to 13,000 men.

(To be continued).

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THE AERONAUTICAL SOCIETY OF GREAT BRITAIN.

TECHNICAL TERMS COMMITTEE.

BY the courtesy of the Aeronautical Society we are enabled to publish the following :—

The need having become pressing for an extension of the preliminary list of Technical Terms published by the Society in 1910, a representative Committee, upon which the Air Departments of the Admiralty and the War Office are officially represented, has been appointed to deal with the matter. It has been decided to publish as an instalment the list of terms annexed hereto. The absence of terms dealing with Stability in the present list is due to the fact that a comprehensive set of such terms, together with others, is under consideration and will be published in due course.

WORD.	DEFINITION.
A	
AEROFOIL.	—A structure, analogous to the wing or tail of a bird, designed to obtain a reaction from the air approximately at right angles to the direction of its motion.
AIRSCREW.	—Used as a generic term to include both a propeller and a tractor screw. See "Screw."
AILERON.	—See "Balancing Flap."
ALIGHTING CARRIAGE.	—See "Carriage."
ANGLE, DIHEDRAL.	—In geometry the angle between two planes. The wings of an aeroplane are said to be at a dihedral angle when both right and left wings are upwardly or downwardly inclined to a horizontal transverse line. The angle is measured by the inclination of each wing to the horizontal. If the inclination is upward the angle is said to be positive, if downward, negative.
ANGLE, GLIDING.	—The angle between the horizontal and the path along which an aeroplane, in ordinary flying attitude, but not under engine power, descends in still air.
ANGLE OF INCIDENCE OR ANGLE OF ATTACK.	—The angle a wing makes with the direction of its motion relative to the air. The angle is usually measured between the chord of the wing and the direction of motion.
ATTITUDE.	—An aeroplane's or wing's position relative to the direction of motion through the air.

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B

BACK, TO.—Of the wind, to change direction counter-sunwise (counter-clockwise).

BALANCING FLAPS.—Aerofoils used for causing an aeroplane to roll about its longitudinal axis for the purpose of balancing.

BALLONET.—A word taken from the French meaning "a little balloon" and exclusively limited to an interior bag containing air, within the envelope of an airship.

BANK, TO.—To heel for the purpose of turning.

BODY.—Of an aeroplane—that part which usually contains the engine, crew, tanks, etc., and to which the wings, carriage, and other organs are attached.

BRACING.—A system of struts and ties to transfer a force from one point to another.

C

CABANE.—A French word to denote the mast structure projecting above the body to which the top load wires of a monoplane are attached.

CABRÉ.—Tail-down.

CAMBER (of a wing section).—The convexity of a wing section. The camber is usually measured (as a fraction of the chord) by the maximum height above the chord.

CANT, TO.—To tilt; to take any inclined position.

CARRIAGE.—That part of the aircraft beneath the body intended for its support on land or water and to absorb the shock of alighting.

CHASSIS.—See "Carriage."

CHORD.—The straight line (taken conventionally fore and aft unless otherwise specified) touching the under surface of an aerofoil at or near the leading and training edges. The length of the chord is the projected length of the section on the chord.

CLINOMETER.—See "Inclinometer."

CONTROL LEVER.—On an aeroplane, a lever by means of which the principal controls are worked. It usually controls pitching and rolling.

CROSS SECTION (of an Aerofoil).—The section cut by a fore and aft plane normal to the surface (commonly the under surface).

D

DIHEDRAL ANGLE.—See under "Angle."

DIVE.—To descend steeply with the nose of the aircraft down.

DOPE, TO.—Of fabrics—to paint a fabric with a fluid substance for the purpose of tightening and protecting it.

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DRAG.—The resistance along the line of flight; the head resistance. Compare "Drift."

DRIFT, To.—To be carried by a current of air or water; to make leeway.

DRIFT.—The distance drifted. The speed of drifting. The word "drift" having a well-accepted nautical significance should be avoided as far as possible in the sense of "head resistance" or "drag."

E

ELEVATOR.—An aerofoil set in a more or less horizontal plane and hinged on an athwartships or transverse line. It is used for controlling the angle of incidence of the aeroplane.

ENTERING EDGE.—See "Leading Edge."

F

FAIRING.—A piece added to any structure to reduce its head resistance or drag.

FINS.—Subsidiary aerofoils set parallel to the normal direction of motion of an aircraft.

FLAPS, BALANCING.—See under "Balancing."

FLAPS, WING.—See under "Balancing."

FUSELAGE.—See under "Body."

G

GAP.—The distance between the upper and lower wings of a biplane. For specific purposes the points between which it is measured should be indicated.

GLIDE, To.—To fly, usually on a descending path, when the aircraft is not under engine power.

GLIDING ANGLE.—See under "Angle."

I

INCIDENCE, ANGLE OF.—See under "Angle."

INCLINOMETER.—An instrument for measuring the angle of slope of an aircraft, referred to the horizontal.

L

LEADING EDGE.—Of a wing—the forward edge.

LEEWARD.—Away from the wind.

LEEWAY.—Lateral drift to leeward.

LIFT.—The force exerted by the air on an aerofoil in a direction perpendicularly or nearly so to the motion. Usually upwards in ordinary flight.

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LONGITUDINALS.—Of an aeroplane, the long fore and aft spars connecting the main with the subsidiary supporting or controlling surfaces.

LONGERON.—See "Longitudinal."

P

PANCAKE, TO.—To descend steeply, with the wings at a very large angle of incidence, like a parachute. Contrast "Dive."

PITCH, TO.—To plunge in the fore and aft direction (nose up or nose down). Contrast this with "Roll."

PITOT TUBE.—A tube with open end facing the wind, which, combined with a static pressure or suction tube, is used in conjunction with a gauge to measure fluid pressure or velocities.

PRESSURE HEAD.—A combination of pitot tube and static pressure or suction tube, which, in conjunction with a gauge, is used to measure fluid pressures or velocities.

PRESSURE TUBE, STATIC.—A tube (usually with holes in its side past which the fluid flows) so designed that the pressure inside it equals the pressure exerted by the fluid on any body at rest in the fluid. Used as part of a pressure head.

PROPELLER.—An air-screw behind the main supporting surfaces. Compare "Tractor."

PYLON.—A mast or post.

R

RIB.—Of a wing, a light fore and aft member which carries the fabric for the purpose of giving the desired cross section to the wing.

RIB, COMPRESSION.—A rib designed to act as a strut between front and rear spars of a wing.

ROLL, TO.—To turn about the fore and aft axis.

RUDDER POST.—The main post of a rudder.

RUDDER.—A subsidiary acrofoil (in an aeroplane more or less perpendicular to the main supporting surfaces) by means of which an aircraft is turned to right or left.

RUDDER BAR.—The foot-bar, by means of which the rudder of an aeroplane is worked.

S

SCREW, AIR.—An aerofoil so shaped that its rotation about an axis produces a force along that axis for driving an aircraft.

SIDE DRIFT.—See "Drift."

SIDE SLIP, TO.—In an aircraft, to move more or less broadside on relatively to the air.

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SKID.—A part of the alighting gear of an aircraft arranged to slide along the ground.

SPAN, OF WINGS.—The distance from wing tip to wing tip.

SPAN, OF AEROPLANES.—The maximum transverse dimension.

SPAR.—A long piece of timber or other material. In a wing, either of the beams which run transversely to the aircraft, and transfer the lift from the ribs to the frame and bracing.

STAGGER.—Of wings. When the wings of a biplane are set with the upper one slightly ahead of, or abaft of the other, they are said to be staggered. The stagger is measured by the angle made by the line joining the leading edges with the normal to the fore and aft axis of the aeroplane. It is convenient to call the stagger positive if the upper wing is ahead of the lower.

STATIC PRESSURE TUBE.—See under " Pressure."

STATOSCOPE.—An instrument to detect the existence of a small rate of ascent or descent.

STRAINER.—An appliance bearing a suitable mesh for straining impurities from petrol and other fluids. Also compare " turnbuckle."

STREAM-LINE.—The path of a small portion of a fluid, supposed continuous, moving relatively to a solid body. The term is commonly used only of such paths as are not eddying, but the distinction should be made clear by the context.

STRUT.—A structural member intended to resist compression in the direction of its length.

T

TAIL.—The after part of an aircraft, usually carrying certain controlling organs.

TIE.—A structural member intended to resist tension.

TOP SURFACE CAMBER.—See under " Camber."

TOP LOAD WIRES.—See under " Wires."

TOP WARP WIRES.—See under " Wires."

TRACTOR.—An air-screw mounted in front of the main supporting surfaces.

TRACTOR MACHINE.—An aeroplane with air-screw mounted in front of the main supporting surfaces.

TRAILING EDGE, OF A WING.—The after edge.

TURNBUCKLE.—A form of wire tightener.

U

UNDER-CARRIAGE.—See " Carriage."

UNDER-SURFACE-CAMBER.—See " Camber."

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V

VEER, OF THE WIND.—To change direction sunwise (clockwise).

VELOCITY OF SIDESLIP.—The speed with which the craft moves broadside on with respect to the air. Distinguish from "drift," q.v.

W

WARP, TO.—Of a wing, to bend so that the outer end of the back spar moves up or down. It is convenient to call the warp positive when the movement is downwards.

WING FLAPS.—See "Balancing Flaps."

WINGS.—The main supporting organs of an aeroplane. A monoplane has two wings, a biplane four.

WIRES, LIFT.—Wires, the principal function of which is to transfer the lift of the wings to the body or other part of the aeroplane structure.

WIRES, WARP.—Lift wires connected to the back spar and controlled so as to move its outer end down for the purpose of warping the wing.

WIRES, TOP LOAD.—Wires intended mainly to resist forces in the opposite direction to the lift.

WIRES, TOP WARP.—Top load wires connected to the back spar and passing from wing to wing to allow the wings to warp.

WIRES, DRAG.—Wires, the principal function of which is to transfer the drag of the wings to the body or other part of the aeroplane structure. Wires intended mainly to resist forces in the opposite direction to the drag are sometimes called "anti-drag wires."

WIRES, DRIFT.—See "Wires, Drag."

WIRE-STRAINER.—See "Turnbuckle."

Y

YAW, TO.—An aircraft is said to yaw when its fore and aft axis turns to right or left out of the line of flight. The angle of yaw is the angle between the fore and aft axis of the aircraft and the instantaneous line of flight.

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TRANSCRIPT.

HISTORY OF UNDERGROUND WARFARE.

(Continued).

Fourth Period.

Under Louis XV., Marshal Vallières and his son did much to improve the artillery, but it is to Gribeanval that we owe the mobile and powerful weapons in vogue during the revolutionary campaigns. These were wars of manœuvre and movement, hence sieges were exceptional, and even at sieges long range weapons placed beyond the glacis were able to breach the parapets. The continuous enceinte was superseded by detached forts, which, as ranges increased, were placed further and further from the point to be defended. These circumstances limited the use of mines, which were little employed except during the Peninsula War. A few other cases may be mentioned, such as the Siege of Valenciennes in 1793, where the Allied Army under the Duke of York succeeded after a month's labour in laying three mines each containing 4,500 lbs. of powder. Owing to delay caused by want of information, countermining was tried too late, the mines were fired and an assault delivered. It failed at the time, but the town was surrendered three days later.

At the Siege of Acre in 1799 the salient of the counterscarp was blown in by a mine, but two assaults following it were repulsed mostly owing to flanking fire from a high tower on the walls. A deep mine, to blow in the tower, was then commenced. The Turks countermined, but too high. Three mines were fired under the tower, and one under the glacis to fill the ditch. The tower was not greatly damaged, an assault failed and artillery had to be brought up to complete the destruction. Another assault failed and the siege was raised.

During the Siege of Saragossa in 1809 the French had only captured a small part of the town after 30 days' operations. The Spaniards had collected the inhabitants into separate blocks of houses divided from each other by wide streets or public places, each block forming a separate fortress with some large building in it constituting a keep. The houses were barricaded and loopholed. Frontal attacks were out of the question, and mining had to be employed. The defenders tried to countermine, sometimes effectually, and it was not till 20 days later that the town capitulated.

Mont Jouy de Girone in 1809, and Valence in 1812, where the galleries had to be driven under a wet ditch, were captured by the French owing to the use of mines. In 1812 the English employed them against the Castle of Burgos. There were no engineers, the first explosion only demolished the wall of the escarp, and left the parapet above almost

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intact, a second charge was better placed, and made a practicable breach which was crowned, but all efforts to advance further failed. The work was carried out by infantry, was very slow, and very trying to untrained and inexperienced men.

At the third Siege of Badajoz the fronts facing the Guadiana were the weakest, and the French had strengthened them by an improvised system of countermines. Wellington knew this, and having no engineers could not hope to succeed in a limited space of time in an attack upon this front. He was compelled to try elsewhere, where not only were the fortifications stronger but an inundation gave additional protection. Numerous and practicable breaches were made by gun fire, but the defenders closed them with sandbag parapets, placed chevaux de frise in front, arranged loops of bombs attached to powder hose, and large barrels filled with tarred straw, grenades, and shells, and posted men to set fire to these and roll them down on the assaulting columns. The counterscarp had not been breached, at the foot of it the defenders fixed another series of bombs under a few inches of earth, and connected together by powder hose covered with gutter tiles. These were fired as the English jumped into the ditch, but did not check the assault. Many men were drowned in a deep trench in the ditch. The remainder were checked by the burning barrels. However a party had managed to scale the St. Vincent Bastion and attacked in rear the defenders of the breach, with the result that a capitulation followed.

The mine defence of the Castle of Mouzon is of interest. The castle was held by 100 French gendarmes against 3,000 Spaniards. All the countermines were planned and superintended by a mine watchman named Saint Jacques who had been at the Siege of Saragossa. The only tools at first available were four pickaxes, three spades, three axes, two hammers and two saws. There were no candles or baskets. Powder was procured from cartridges, candles from melted bullocks' fat, and more tools were captured from the Spanish mine galleries. The place held out from the 27th of September, 1813, to the 18th of February, 1814, when the captain in command ascertained that the French were everywhere in retreat, and capitulated. On no single occasion did the Spaniards fire a mine, Saint Jacques and his men were too quick for them, or the mines were destroyed by sorties.

At the time of the Revolution the globe of compression had given birth to several countermine systems, the general characteristics of which were the omission of the envelope gallery at some distance in front of the counterscarp, and the use of listening galleries disposed as antennæ, whether connected together or not by a transverse gallery some distance in rear of the listeners. General Marescot, the first Inspector-General of Engineers, initiated in 1802 a competition for a treatise on mining. This produced the classic works of Mouzé, Gillot, Gumpertz and Lebrun, which obtained first and second prizes, and honourable mention respectively.

Mouzé's system of attack was based (1) on Belidor's idea that it was easy to invade the countermines after exposing them by an explosion, (2) on the utilization of Boule's shafts, and (3) on experiments made by himself with regard to the omission of tamping. Mouzé sited his

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last parallel 52 yards from the nearest listeners, thus assuming *a priori* that the plan of the countermines was known, and from it made a series of attacks by mining without explosives, whilst he pushed on by flying saps over the ends of the listening galleries. There he sank Boule's shafts, which he estimated would take three hours each, placed in each 1,650 lbs. powder, or almost enough to fill it, laid a cover on the top and fired it. Eight miners then excavated in each crater to find the broken gallery, which Mouzé estimated would take an hour, and each gallery was invaded by a party of grenadiers and workmen. They barricaded themselves in the envelope, and thence pushed on to the counterscarp gallery.

Gillot was bolder, proposing to advance by zigzags from the third parallel, and to sink his shafts over, and blow in each listener with 300 or 400 lbs. powder. If the positions of the listeners were unknown, a row of mines at 20-ft. intervals could not fail to find them. Here the fourth parallel was sited, whence the salient place of arms and counterscarp gallery were attacked by shafts. Thus, whatever the countermine system, Gillot in three nights rendered it useless, and reached the counterscarp.

Gumpertz and Lebrun, inspired by Lefevre's advance at Schweidnitz, drove inclined galleries from the last parallel for 35 yards and fired three mines 44 yards apart with as large a L.L.R. as possible. He considered that at 9 yards depth in compact earth, 6,000 lbs. powder should produce craters of which the radius was double the L.L.R. From these craters the attack again advanced, and it was estimated that the counterscarp would be reached and demolished after 45 days' mining, assuming that the attack made no mistake and that the defenders confined themselves to looking on.

From 1815 to 1823 Lebrun was writing a work on countermines. He proposed to build one tier of galleries in earth up to 16 or 26 ft. deep, and if the earth were deeper, two tiers of galleries, the upper to attack the enemy's earthworks, the lower, his mines.

The most striking feature of Mouzé's and Gillot's methods is their overwhelming impetuosity; this probably reflects the military spirit of the times. The garrison would have to be deprived of all energy which could not put a stop to the sinking of the shafts; even if too weak to make a sortie it could considerably delay the work by plunging fire from the ramparts. The firing of even one countermine would send the workmen back to their parallel, and it would be difficult to induce them to face the work again.

This bold method of attack by shafts, however, produced modifications in the design of countermines, and in 1820 Colonel Rohault de Fleury invented a system of "countershafts," *i.e.* mines placed over the ends of the listeners just underground, so that their craters would give no cover to the assailants, and so far above the gallery roofs that a charge capable of damaging the enemy's galleries, would leave the protected gallery unharmed. This system was only introduced slowly, owing to its practical difficulties. At first excavations were made down to the roofs of the listeners, which were protected by shields, but in 1828 Colonel Thuillier invented the first camouflet machine, which enabled the deep excavation, and consequent disturbance of the soil over the

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gallery, to be omitted. It also permitted of placing the mine from the gallery, and loading it by cartridge. These mines were then called "countershaft camouflets." The *attaque brusquée* was thus put a stop to.

Following on improvements in ventilating and firing apparatus, countermine systems were simplified. In the same gallery charges were laid in pairs, that furthest in front was first fired, that in rear, placed in the tamping of the former, exploded into the first crater. The new fuze gave so little smoke, and the renewal of air was so rapid, that it was even found possible to fire the first charge before tamping and firing the second.

Shortly afterwards it became customary to place a charge in position after the tamping was finished, the use of bored mines facilitated this procedure. The idea was not a new one, as a modified form of bored mine had been used at Candia, but now assumed fresh importance owing to the introduction of improved boring apparatus. For a time it was considered that the attack had acquired such a valuable weapon that the countermine was doomed, but practical experience proved that this opinion was not justified. The drill was frequently stopped by stones, or the ground was so hard that large numbers of men were required to work it. The Siege of Sebastopol finally burst the bubble of the bored mine, principally because it was found impossible to expose more than two or three men at a time under curved fire. Boring however still had its uses as a method of underground reconnaissance.

Major Laloy tried at Arras in 1854 an improved method of procedure analagous to that of Lefevre at Schweidnitz, but gave the miner some protection against the countermines of the defence, and considerably shortened the interval of time between each explosion. To fulfil the first condition 5 to 7 ft. of cases were erected and covered with earth in the first craters, which were to be opened by large mines at some little distance from the countermine system. Inclined galleries were then driven as far as verticals through the front edges of the first row of craters. The earth piled on the cases placed above ground in the craters, acted as additional tamping, and prevented the effect of the mine at the end of such a short gallery taking place backwards. If the defenders fired a countermine, part of its effect would only be to throw more earth into the crater and increase the L.L.R. In ordinary ground successive globes of 900 to 1,000 lbs. could be placed and fired at 12 to 15-hour intervals, securing an advance of about 13 ft. on each occasion. The mines were placed in rows close enough together to leave nothing untouched between them.

Thus at the opening of the 19th century the art of mining was held in great estimation, but countershafts, and charging after tamping were hardly applicable in actual warfare. The Siege of Sebastopol demonstrated that the most simple processes were the only practicable ones, but the attackers were confronted by worthy antagonists. The Russians were past masters in the art of underground warfare, and had acquired practical experience of it at Brailov and Varna during the Russo-Turkish War in 1828.

The fortifications of Brailov consisted of a semi-circle of small bastions

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joined by long curtains, the ditch was dry, with revetment walls. The place contained a large garrison, and communication across the Danube was open. There were no countermine galleries. On the 11th night of the siege three covered saps were pushed from the third parallel, two towards No. 1 Bastion, and one towards No. 2. A large mine of 8,500 lbs. powder was placed against the counterscarp between the Danube and No. 1 Bastion, six of 800 to 1,000 lbs. each in a gallery behind the counterscarp on the attackers' left of No. 1 Bastion, and another of 8,500 lbs. under the foundations of the escarp. Two mines of 2,500 lbs. each were placed under the escarp of No. 2 Bastion, and four of 800 to 1,000 lbs. each along the counterscarp. These were to be fired simultaneously in three groups, (1) the large mine near the river, (2) the mines of No. 1 Bastion, (3) the mines of No. 2 Bastion, and an assault launched immediately. The signal to fire was to be three rockets. Unfortunately the officer in charge of No. 1 Group fired after the second rocket, and buried the junction box of No. 2 Group, consequently when the third rocket went up only No. 3 Group could be fired. Practicable breaches were formed by the mines which exploded, No. 1 having thrown a quantity of earth against the escarp opposite. The assault was delivered, but failed. partly owing to the stubborn resistance of the Turks, partly because the right column had to make a flank march, and lost heavily in doing so, and partly because the earth thrown by No. 1 Mine against the escarp slipped down under the feet of the attackers, and was soon too steep to climb over. The left assault reached No. 2 Bastion, but was there forced back, and 1,500 to 1,800 men were lost in a counter-attack. Next day the second group of mines was fired, all the craters crowned, and the ramparts heavily shelled by artillery. A sortie was repelled, and next day the place was surrendered after 24 days of open trenches.

In a report of the siege written by an artillery colonel it is stated that breaches might easily have been made by the guns more quickly than by mines, but the engineer corps dominated the siege, which was conducted by its first Inspector-General. The failure of the second group of mines shows how important it is in war to avoid complicated methods. It would have been better to fire each mine separately. In regard to this criticism it may be considered doubtful whether the artillery could have demolished the counterscarp walls, even if they had succeeded in making practicable breaches in the escarps. Certainly the absence of countermines contributed largely to the rapid success of the Russians.

The fortifications of Varna were much the same as those of Brailov. The Russian left rested on the Black Sea opposite No. 1 Bastion, which was separated from the sea by a ditch 170 ft. wide. The counterscarp was formed by a cofferdam cutting off the waters of the ditch from the sea. Between Nos. 1 and 2 Bastions, at right angles to the seashore, the ditch was 190 yards wide opposite the curtains. In the middle of the ditch was a stream which formed several pools. Trenches were opened on the 7th of August, 1828. The escarp of No. 1 Bastion was soon breached by gun fire, and opposite the breach five shafts, 56 ft. apart, were sunk, and 1,200 lbs. powder placed in each to blow down the counterscarp. These were fired about a month after the commencement

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of the siege, but the earth thrown into the ditch was not nearly enough to fill it, and no assault could be attempted. The Russians then worked along the outside of the cofferdam, and also drove covered saps across the ditch. No. 2 Bastion was attacked similarly. Here the bed of the stream was very deep, but at length one mine of 5,000 lbs., and another of 2,000 lbs. were placed under the escarp. The quantity of powder would have been increased, but the Turks showed signs of countermining, and it was decided to hasten the explosion. No. 1 Bastion was breached on the 21st of September, and No. 2 on the 22nd. The Turks had prepared a retrenchment in rear, and an assault would have failed. It was decided to make new breaches in the curtain, but the town was surrendered on the 28th. Had the Turks known a little about countermining the Russian works would have been very much delayed.

SIEGE OF SEBASTOPOL.

Omitting any description of the surroundings and fortifications, the mining operations only will be touched on. Trenches had been opened on the 3rd of October, 1854, and by the 1st of November the third parallel was at 170 yards from the Flagstaff Bastion. The French commenced their galleries on the 20th, with the intention of breaching the bastion prior to an assault. Two shafts were sunk into the rock, when a bed of clay was found in which progress was rapid. It was not anticipated that the Russians had any countermines, and the first intimation of their existence was the blowing in, on the 3rd of February, 1855, of the head of the right gallery by a camouflet.

At the beginning of November the defenders thought they heard sounds of mining, and Colonel Todleben decided to organize a system of countermines. (On the 1st of January he received a plan of the French siege works which had been lithographed in Paris). His plan was to excavate an envelope gallery under the ditch of the bastion, with listeners at right angles to it. Twenty shafts were sunk into the same bed of clay which the French had discovered, but Todleben was not satisfied that his first scheme afforded sufficient protection, and relying on the motto that "the lower man has the upper hand," commenced a lower tier of galleries in a second layer of clay about 50 ft. below the surface. This lower tier comprised 480 yards of gallery, and was never used, but a mine of 9,000 lbs. of powder was discovered after the siege, at the end of one of the galleries. The lower tier had, however, a great moral value in relieving the miners in the upper galleries from the apprehension of being undermined.

Finding that they could not surprise the enemy, the French now determined to join up transversely their own principal galleries, to drive a series of galleries for mines the craters of which would intersect, to fire them simultaneously and so open a fourth parallel. After several mines had been fired on both sides the series of mines was charged by the 10th of April. There were twenty of them, varying from 1,200 to 4,200 lbs. each, up to a total of 57,000 lbs. After the explosion the craters were occupied and gave excellent cover, but a few mines had failed, and some craters had to be joined by sap. Owing, however, to the incessant fire and sorties of the garrison this parallel could only be occu-

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pied at night. It was connected up to the third parallel by some mine craters joined by saps. The mines which had missed fire were untamped and fired by degrees, not without casualties to the French troops.

The action of the mines had not extended far, and the Russians were soon able to repair their galleries and advance again. The French therefore practically only held the rear slope and bases of the craters. However, they were able to put listeners on a banquette on the forward slope to give notice of attempts on the Russian side to mine under the parallel, and to drive them away by mines placed in hastily excavated shafts. In other words the attackers were reduced to defensive tactics.

Meanwhile the Allies had realized that the capture of the Green Mamelon, which commanded Fort Malakoff, would entail the fall of Sebastopol. The attack on the Flagstaff Bastion thus became of secondary importance, and was only continued to occupy the attention of a portion of the garrison, and as a defensive measure, to prevent their advance under the fourth parallel. A number of fougasses were fired from that parallel, as the bastion was within range, but besides annoying the Russians they did a considerable amount of damage to the French galleries in rear.

On the 2nd of May the French had armed a battery, No. 53, against the Central Bastion and the Schwartz Redoubt which covered its left flank. In the middle of May the Russians, in expectation of a possible subterranean attack in this quarter, opened countermine galleries of similar design to those at the Flagstaff Bastion. On the 14th of August, hearing the noise of a deep sap by which the French were connecting Battery 53 with a stone quarry on its left, they fired a mine in a hurry. It did no damage to the French, and was a lucky event for them, as a few days later the Russians would have been under the battery. A subterranean war now began in front of Battery 53. Several mines were fired, but neither side gained any particular advantage.

Countermining was commenced somewhat tardily from the Malakof, on the same principles as before. Fourteen listening galleries from an envelope gallery were driven at right angles to the counterscarp, and stepped shafts in the rock led down to another tier of countermines 50 ft. beneath the glacis. By the 8th of September the upper listeners had advanced 20 to 40 ft., and four lower listeners about 17 ft. When the French obtained knowledge of these works they sank twelve shafts, from which galleries ran towards the salient of the fort. On the 6th of September, the date of the assault of the Malakof, the only three mines which there had been time to charge were fired at eight in the morning. These mines would certainly have damaged any countermines within reach, but the main object in firing them was to prove to the troops of the assault that their own miners held the mastery of the subsoil. The capture of the Malakof ended the siege. It was rendered possible only by the delay of the Russians in countermining. The latter had been preoccupied by the defence of the town, but had the countermines of the Malakof been in a more forward state, the result might have been different.

On the French side the length of gallery and branches was about 1,200 yards in front of the Flagstaff Bastion, and 130 yards before the

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Schwartz Redoubt. The Russians excavated 3,000 and 2,200 yards respectively, and 550 yards in front of the Malakof. Before the Flagstaff Bastion there were 125 explosions, and before the Schwartz Redoubt 11 only. The total weight of powder consumed in mines was 115,000 lbs., as compared with 6,600,000 lbs. expended by the artillery, but of 176 casualties amongst the French miners, including 17 killed, only 4 were killed in the galleries. This must be attributed in some measure to careful listening. The Russian miners incurred 191 casualties, including 54 killed; out of these 24 were killed and 32 wounded in the galleries.

The French mines established for opening the fourth parallel were each provided with two distinct means of firing, firstly, La Rivières fuze laid on the ground, each length starting from junction boxes filled with 4½ lbs. powder, and secondly, ordinary powder hose laid in troughs and starting from the same junction boxes as the respective lengths of fuze. There were six misfires, which may have been due to the different rates of burning of the fuze and powder hose. Symmetry in the means employed for the double transmission of fire is most necessary.

Several cases of suffocation occurred in the galleries. Very thorough ventilation is necessary, and apparatus should be at hand enabling foul mines to be entered with impunity.

The Russian countermines started very regularly, but once contact with the enemy underground was established all semblance of regularity was lost. Each miner seems to have worked independently, without reference to his neighbours. The drawbacks to following no definite plan are self-evident: not only might a great deal of the work done have been saved, but it must frequently have been impossible to distinguish sounds made by the enemy from those made by a neighbour, and no large mine could be fired without damaging adjacent galleries. The lower tier of galleries was almost useless for mines. The 9,000 lbs. mine found after the siege would only have been a huge camouflet, as there were 17 yards of rock above it. This criticism does not imply that a lower tier is in no case necessary, it gives confidence to those working above, but should not be commenced, when time presses, until the upper tier has been completed.

The Russian gallery cases were frequently fixed very carelessly. This may have been due to rapidity of execution, which in mine warfare is the first condition to be fulfilled. On the other hand the tamping, which consisted of sandbags strengthened by wooden frames, was finished most minutely, interstices being often closed with rags. Voltaic batteries seem to have been used for firing the mines, and it is probable that misfires were frequent.

In front of the Carenage Battery the Russians had placed a row of boxes each containing 15 to 20 lbs. powder, and destined to be fired by a liquid escaping from a glass tube, which would be broken by the steps of the assailants. These land mines were discovered before the attack.

(*To be continued*).

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REVIEW.

MILITARY POLICY OF THE BRITISH EMPIRE.

In last month's *Supplement* we briefly called attention to the publication under the editorship of Colonel B. R. Ward, of the 5th edition of Sir Charles Pasley's *Military Policy of the British Empire.*

The first edition of this wonderful work appeared in 1810 when England was engaged in her great life and death struggle with Napoleon, and by a curious coincidence the present edition appears when we are again engaged in a similar struggle against Germany. Under these circumstances the book will be read with particular interest, and the eulogistic reviews which have appeared in the Press show how well worthy the book is of careful study.

Punch in "Our Booking Office" confesses that he has hitherto been among the number of civilian readers "to whom the name of Pasley conveyed nothing," but, he adds, "if you are at all concerned with the science and policy of arms (and who nowadays is not?) you will find this book of extreme interest."

The Spectator deals more fully with the essay and in a long and able review gives some idea of its sensational first appearance in 1810. "So great was the sensation," writes the reviewer, "caused by the work of the gallant 'Captain in the Corps of Royal Engineers' that edition after edition was called for, and women as well as men, indeed the whole of the reading and thinking public in the country, devoured the essay. For example, we find several references to it in Jane Austen's letters. She expresses her delight in her own inimitable fashion: 'I never sighed for a soldier before.'"

The following extracts are also taken from the same review:—

"Pasley's noble and far-seeing book was written in 1810, when Napoleon was at the very zenith of his power, and when most people in these islands had despaired of the republic, except on the sea, and considered that it was useless to attempt to interfere with Napoleon's domination on land. It was Pasley's glory that he bade his countrymen not to despair, but to look for the coming of the day of deliverance which he predicted was at hand. A second edition of his book appeared in the spring of 1811, and a third in the autumn of that year. A fourth was published in 1812, when Napoleon's army was in full retreat from Moscow. The publication of a fifth edition was contemplated in the winter of 1848, but Pasley's intention was never carried out.

"Pasley's main idea is that we cannot be safe unless we have military power as well as naval power, that we have the capacity for making

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ourselves into a strong military Power, and that what we chiefly need is its adequate direction. He points out that our difficulty is not lack of soldiers—of these we possess enough—but the knowledge of how to use them, and also a clear understanding of what we want—*i.e.*, a true objective. If we have not got a well-defined military policy, we are sure to fail in our military operations. That, of course, is as true now as it was then. Here are Pasley's own reflections in his own words :—

"'I must observe, in the strongest manner, that no Great Power, in the critical situation in which Great Britain now stands, was ever saved by coalitions. *We must trust alone to our own arms. Wherever we display our standard, we must draw the sword with the spirit of principals, not of auxiliaries ;* and we must never cease to increase our own power by conquest, until we make ourselves the strongest Power in Europe, by land as well as by sea. If we neglect to use every exertion in our power to effect this purpose, it may prove of little use to us or our posterity should we, by any chance, escape being enslaved by France. *For if that Empire were to fall to pieces, new difficulties and dangers would gather around us. Germany might become so powerful as to act the same part in Europe which France now does.* Spain might, as she formerly did, threaten to reduce us to a province ; or, if we ever suffered ourselves to dwindle into a third Power, how could we promise to ourselves, that two of the neighbouring states might not coalesce, in order to divide our country between them.'

" Pasley, of course, wrote with Napoleon always before him, but it is a proof of the penetrating quality of his mind that he is able to look beyond the immediate struggle and see, as in one of the passages we have italicized, that the day may come when a German ruler will play the part of the great Corsican.

" In the fullest sense Pasley's essay is a great book by a great man. It shows on every page of it the authentic spirit of patriotism. If Pasley is often wrong in detail, in the highest sense he is always in the right. He has the true vision. He may be on occasion a little too emotional, but, on the other hand, he is never inhuman. He never anticipates Nietzsche or the 'ruthless, relentless, remorseless' war policy which now governs the minds of the ruling caste in Germany. Indeed, it is remarkable to note here the difference between Pasley's work and that of Clausewitz, the great metaphysician of war, from whom the soldiers and statesmen of Germany draw their inspiration in the matter of military policy. Clausewitz is a cold-blooded logician. Pasley insists always on the need of observing right and justice and fair play to other countries.

" We wish we could quote from the main portion of Pasley's essay, but space, unfortunately, fails us. We would advise our readers, however, most strongly to read the book for themselves. They will gain from it many useful lessons. Meanwhile, we may quote one or two of the maxims which the editor has drawn from the essay in order to illustrate Pasley's insistence on justice and fair play as factors in military policy :—

"'National ambition is only criminal or unjust when it passes the limits of necessity.'

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"'It is an advantage in war to show moderation and justice, when these qualities are united to a martial spirit.'

"'A scrupulous adherence to the law of nations and an inflexible constancy in the cause of deserving allies is the only sound policy.'"

The essay called forth a passionate eulogy from the poet Wordsworth and portions of his letter to Pasley are reproduced in a later number of *The Spectator*. "Let me express," he writes, "my zealous thanks for the spirit and beauty with which you have pursued through all its details the course of martial policy which you recommend. Too much praise cannot be given to this, which is the great body of your work. I hope that it will not be lost upon your countrymen."

In fact it is not too much to say that Pasley's *Military Policy of the British Empire* played a considerable part in moulding the policy of the succeeding years of the great struggle in which we were engaged, and Colonel Ward deserves the thanks of the Corps for having again brought it to the notice of the British Public.

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RECENT PUBLICATIONS OF MILITARY INTEREST.

REVIEW OF BOOKS.

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BIOGRAPHY AND HISTORY.

RUSSIAN OFFICIAL HISTORY OF THE RUSSO-JAPANESE WAR. Vol. IV., Parts I. and II.* THE BATTLES ON THE SHA HO. (Guerre Russo-Japonaise, 1904—1905. Historique rédigé à l'état-major général de l'armée russe). Part I., 625 pp. with 48 maps; Part II., 794 pp. with 28 maps. 8vo. Paris, 1912. Chapelot. £1 5s. each part.

Vol. IV. takes up the story from the arrival of the Russians at Mukden, after their retreat from Liao-yang, and deals with the fighting on the Sha ho and the Battle of San-de-pu. Part I. is occupied solely with the fighting on the Sha ho: Part II. with the Battle of San-de-pu and Mishchenko's raid.

The introductory note, repeated in every volume, should be read attentively; it explains certain peculiarities of the Russian organization, and gives a useful list of Russian terms which have been retained in this French text.

Part I. contains 13 chapters, 49 appendices, and 21 notes.† The chapter headings are as follows:—

Chapter I.—The situation in Manchuria between the retreat from Liao-yang and the commencement of the offensive on the Sha ho.
Chapter II.—The plan, organization and preparation for the offensive.
Chapter III.—The operations of October 5th and 6th, 1904.
Chapter IV.—Events of October 7th and 8th.
Chapter V.—Events of October 9th.
Chapter VI.—Events of October 10th.
Chapter VII.—Events of October 11th.
Chapter VIII.—Events of October 12th.
Chapter IX.—Events of October 13th.
Chapter X.—Events of October 14th.
Chapter XI.—Events of October 15th.
Chapter XII.—Operations of October 16th. The attack of Putilov and Novogorod Hills. The end of the operations.
Chapter XIII.—The organization of the Russian rear for the Battle of the Sha ho.
Appendices.—Notes to Vol. IV., Part I.

The maps are in a separate portfolio.

* Previous volumes have been reviewed in *The Army Review:* Vol. I., Part II., in July, 1911, p. 189; Vol. II., Part I., in April, 1913, p. 648; Vol. II., Part II., in April, 1914, p. 539; Vol. III., Parts I., II. and III. in July, 1914, p. 293.

† The notes are by the French General Staff; those contained in the Russian text have been in the main omitted.

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Chapter I. first describes the situation about Mukden, and shows the cause which led General Kuropatkin to adopt the offensive after his retreat from Liao-yang.

By September 8th the Russian Army was established in prepared positions about Mukden, and was fast recovering in organization and in *moral* from the effects of its retreat from Liao-yang. It appears that General Kuropatkin had quite intended to fall back beyond Mukden if pressed; but when he found that his retreat was unmolested, he realized that the Japanese Army was probably exhausted and in a critical condition at Liao-yang. Mukden contained large stocks of supplies and the neighbourhood possessed valuable resources which ought to be denied to the enemy. It was possible and desirable to halt there, and at first General Kuropatkin's attitude was strictly defensive. But his thoughts turned to the possibility of taking the offensive; his troops were in good spirits and well equipped, the season was favourable for marching, his own reinforcements were coming in, while the Japanese were known to be striving to send out drafts. Port Arthur was calling for relief, and undoubtedly the enemy would now redouble their efforts to take it. The influence exerted by Port Arthur was considerable. Personally, Kuropatkin did not share in the apprehensions for the security of Port Arthur, and he objected to repeat Vafangou (Te-li-ssu) for all Stossel's appeals for succour; but the arrival of three fresh corps gave a new impulse to the idea. Kuropatkin decided to take the offensive, and prepared to do so; but as will be seen he was unable whole-heartedly to take the initiative, he made reservations, and would revert to the defensive if the enemy became active.

On September 16th and 17th Mishchenko and Rennenkampf reconnoitred the Japanese positions about Yentai and Pien-niu-lu-pu. The information gathered though not very positive, indicated that the Japanese were in strength on the east flank, it confirmed Kuropatkin's fears for his left and influenced his plan in making him deliver his principal attack from that side.

The story of the capture and execution of Ryabov, a Russian scout taken in disguise by the Japanese, gives an insight into the staunchness of the Russian peasant character, and the appreciation of it by the foe (p. 20).

Chapter II. deals with the preparation and issue of orders for the advance. The principal object of the offensive was "to defeat the enemy and relieve Port Arthur." The Army was divided into two main groups and a general reserve. The Eastern Force under General Stakelberg was one-third of the whole, its task was to seize Pien-niu-lu-pu, and envelop the right flank of the Japanese. The Western Force under General Bilderling comprised one quarter of the whole; it was to act on both sides of the railway, and contain the enemy. The general reserve of two corps was in the rear of the centre, and one corps* over which General Kuropatkin had only a limited control was arriving at Mukden.

In addition to the operation orders, special instructions were issued to the commanders of the two groups. It is these instructions which reveal how Kuropatkin was unable to dissociate from his mind the idea of acting defensively: "If the Japanese are encountered advancing, the Eastern (or Western) Force must take up a defensive position and hurriedly entrench." This anxiety to entrench cost the Russians dear, and largely contributed to the failure of the plan. General Kuropatkin also thought fit to issue to all commanding officers of units a pamphlet of "Guiding Principles" which indicated the tactics to be employed. In these, too, some emphasis was laid on the value of the defensive. Lastly, Kuropatkin addressed a special memorandum to commanding officers on the manner of executing the plan of advance. Many details in this document might have been left to lesser commanders to arrange: commanders and troops were over-instructed in regard to the impending operations.

The arrangements for intercommunication are interesting.† Two or more of the corps of each group had to construct telegraph lines to the Army Headquarters,

* VIth Siberian Corps. See p. 31.

† In the Russian Army the lesser unit must provide the means of communication to the greater.

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and as an alternative means of communication, relays of despatch riders were provided parallel to the wires used by the commanders of the Eastern and Western Forces. In other cases the corps were required to arrange for relays to convey messages only until their telegraph line was in working order.

The latter part of the Chapter II. gives a full description of the theatre of operations. Generally described the eastern part was mountainous, sparsely populated, difficult for troops to traverse, and little known, the available maps being inaccurate; the western portion lay in the plains, and had fairly good roads, but the *kaoliang* hampered the movement of troops.

Chapter III. opens by describing the situation on October 5th prior to the Russian advance. Pp. 96 to 100 narrate the operations of the Eastern Force, whose three columns were directed concentrically on Pien-niu-lu-pu, and the outermost of which had to cover 30 miles on this day. The information obtained by Mishchenko's and Samsonov's reconnaissances on October 4th had showed that the enemy was strongly entrenched at and east of Yentai. As regards the Japanese right at Pien-niu-lu-pu, General Kuropatkin had informed Stakelberg that the Japanese were relatively weak there. This was true. Umezawa's brigade at this point was in a dangerous position, and Kuroki on his own responsibility gave orders for it to withdraw. Although the Eastern Force had come into touch with the enemy's right on October 6th, the scanty details available were not considered sufficient for offensive operations, the Russian maps were found to be quite unreliable, and Stakelberg ordered an extensive reconnaissance for October 7th; he proposed to prepare his troops on the 8th, and deliver his attack on October 9th. Such dilatory procedure could hardly be compatible with the vigorous offensive, but General Kuropatkin appears to have been satisfied with these proposals.

The narrative then turns to the operations of the Western Force. The Commander-in-Chief had cautioned General Bilderling to use the utmost prudence in his first moves, and in accordance with his instructions the latter chose alternative positions—north and south of the Sha ho respectively—to be occupied in case the enemy should become active. The Russian account says: "This was not considered to be in any way contrary to the offensive character of the intended operations."

The Western Force began to move on October 5th, and on October 6th, when General Bilderling found that the Japanese were offering no serious resistance, "he decided to accept battle south of the Sha ho"—a very modified idea of the offensive!

The Manchurian Army had crossed the Hun ho by the evening of the second day, but was exhibiting the utmost caution in its movements.

The Commander-in-Chief also showed his cautiousness in regard to both his flanking detachments; he restricted the wide turning movement which Rennenkampf proposed to make on the east, and he held back Dembovski on the west.

Chapter IV. shows how little was done by the Russians during the third and fourth days of their hesitating advance. On the Japanese right, Umezawa had waited until dark on the evening of October 7th and had then withdrawn his brigade undetected by the enemy. The news that Pien-niu-lu-pu was evacuated was received with incredulity on the morning of October 8th, and the Russians very cautiously occupied it during that afternoon.

Pp. 152—153 give an account of General Rennenkampf's engagement on October 8th at Wei-ning-ying, when he attacked the extreme right of the Japanese position, which faced east covering Pen-hsi-hu. A squadron and four horse artillery guns sent to the high ground on the left (south) bank of the Tai-tzu ho enfiladed the Japanese line, and obliged them to fall back. But this success was not followed up.

The Japanese were now forming up in line 7 miles north of Liao-yang, Oku's IInd Army with its left on the Sha ho, Nodzu's IVth Army astride of the Mandarin Road, and Kuroki's Ist Army at Yentai Mines with his right flank drawn back to the Tai-tzu ho at Pen-hsi-hu.

Chapter V.—The Russians had no fresh news on the morning of October 9th. The Commander-in-Chief directed General Stakelberg to limit his operations on that day to the attack of the advanced positions; he was to get into "positions of readi-

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ness" for a decisive advance to envelop the Japanese right flank. The ground of this flank is described in detail: the country was mountainous, very complicated for troops' movements, and the position occupied by the Japanese was precipitous in front and offered no facilities for attack by night. Indecisive fighting occurred. Rennenkampf's troops again were hotly engaged, gained ground and lost it. The Eastern Force had not achieved any real success by the end of the fifth day.

The task of the Western Force on October 9th had been to keep the enemy employed. General Bilderling proposed to move with some ostentation over the Sha ho, still keeping his troops astride of the railway. The Russians met with a local success at Ho-ti-ku and Wu-lai-tai-tzu. Ho-ti-ku, a prominent hill feature just east of the Mandarin Road, and some 3 miles south of the Shi-li ho, was held by about a battalion of the enemy. The Russian commander used one company, covered by artillery fire, in a frontal attack, and under shelter of the railway embankment moved up seven companies to turn the position, which was then hurriedly evacuated by the Japanese. Only a small part of the troops in the Western Force was in action on October 9th, and much entrenching was done by the remainder. On this day a new group was formed in the centre, consisting of the IVth Siberian Corps and Mishchenko's mounted troops; it made fair progress and definitely located the main position of the enemy on a line east and west of Yentai Mines.

The net result of the fifth day showed little progress. The Eastern Force was blocked in the passes and had to leave some of its artillery behind. The Centre and Western troops had gained a little ground, but had not facilitated the task of the Eastern Force; according to the official account the Manchurian Army was now in temporary positions from which it would commence decisive operations.

On the other side, all three Japanese armies had received orders to advance, relatively weak numbers were engaging the Russian Eastern Force, taking advantage of the strong natural features on the east. Marshal Oyama was preparing to fall on the Western Force.

Chapter VI.—General Stakelberg finding that he was stubbornly opposed decided to suspend his attack and devote October 10th to further reconnaissance. He issued orders to the Eastern Force to continue entrenching itself where it was. Meanwhile the Commander-in-Chief, unaware of the situation of the Eastern Force, sent Stakelberg instructions to wheel his force to the right and take up a line extending to the Tai-tzu ho, which implied possession of the positions still occupied by the Japanese. Stakelberg replied that he could not execute these instructions before October 12th or 13th; and General Kuropatkin assented, but piously hoped that "not a single day would be lost without serious necessity." Stakelberg then issued orders for the Eastern Force to attack at dawn on October 11th.

Pp. 189 to 193 relate the story of the fighting on the left flank in which a detachment of IIIrd Siberian Corps under Colonel Garnitski took part. These troops had not received the order to stand fast, and on the morning of October 10th were advancing against the Shih Shan (Lautkalaza) position under cover of fog. Suddenly the mist cleared, the attack was revealed and came under heavy fire, but many of the troops were able to reach dead ground. The subsequent tactics employed by the Russians furnish good examples of the use and abuse of covering fire. Two companies of Colonel Nekrasov's battalion pushed forward covered by artillery fire which kept the Japanese off the crest of the position, but later the Russians were unable to deliver the assault and were forced to fall back by the fire of their own guns.

On October 10th General Bilderling received orders that the Western Force was to entrench on a line approximately that of the Shi-li ho. In advance Ku-shu-tzu (a little south of Ho-ti-kou) was to be occupied with three battalions from the Xth Army Corps, and Temple Hill opposite the centre was also held.

About 1 p.m. troops of the Japanese 5th Division tried to turn the Russians out of Ku-shu-tzu and delivered three attacks during the night all without avail. About 3 p.m. Oku's troops attacked Erh-tai-tzu held by some of the XVIIth Army Corps. The Japanese counterstroke on the Russian right front was now developing; Oku's 4th Division was also endeavouring to envelop their right, covered by the 1st Cavalry Brigade which had moved out to Sandepu near the Hun ho. On the night of October

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10th—11th the Japanese moved in closer to their enemy with a view to a general advance next morning.

October 10th was a fateful day; on it the initiative passed from the Russians to the Japanese, who had divined their opponent's plan, realized that the Western Force was the weaker, and were proceeding to crush it. The 1st Army Corps of the Russian General Reserve was now on the Sha ho and close behind the Centre: the VIth Army Corps was behind the right about 10 miles in rear of the fighting line. General Kuropatkin considered the latter corps his "strategical reserve," but he had given General Bilderling permission to call on it for aid in the event of the Western Force being pressed by the Japanese.

Chapter VII., the longest in this volume, deals with the turning point of the battle. The morning of October 11th found General Kuropatkin still persevering in his plan. The Western Force was to stand fast, the Centre was to press forward, while the Eastern Force attacked and rolled up the Japanese right. The Russians had now definitely located the three Japanese armies, but were under the false impression that the Ist Army was reinforcing towards the east. The Eastern Force continued to act in two main groups: the Ist Siberian Corps was to attack the Chengkou Ling, Tu-men-tzu Ling and Ta Ling, the IIIrd Siberian Corps to storm Shih Shan (Lautkalaza), and the IInd Siberian Corps remained in reserve. General Stakelberg gave out that the object of the operations was the attack of the Japanese advanced positions, and the occupation of the passes at all costs. The front of his operations was about 14 miles, and he did not discover until later that he was actually attacking the main Japanese position. The orders emphasized the importance of keeping up communication between the troops, flag signalling being specially mentioned—a branch of signalling which had been little developed in the Russian Army. The south-eastern part of Shih Shan, known also as Rocky Hill, was the scene of desperate fighting (pp. 221—227). The Russians gallantly endeavoured to scale the natural walls of the Japanese position. The Japanese did great execution by the time-honoured method of dislodging boulders, and hurling stones, and even the corpses of their dead, upon the escaladers. The Russians could not progress, but they were not defeated, and they prepared to renew the attacks at nightfall.

The attacks of the Ist Siberian Corps under General Gerngross were no more successful. The natural obstacles and the Japanese resistance were too great, notwithstanding that the attacks were continued through the night. A good description of the preparations for, and the execution of, a night attack on the Ta Ling by seven companies of the 34th East Siberian Rifle Regiment is given on pp. 238—240.

The swinging blow by Kuropatkin's left had been parried by the Japanese right; their counter was now falling upon the Russian Centre. The brunt of this counterstroke fell upon the IVth Siberian Corps and the troops under Generals Mau and Mishchenko. Fierce fighting took place on Temple Hill, Nan Shan, and Doublehorned Hill.

General Kuropatkin's concern for his men is exemplified on p. 276. Two companies of the Novocherkas Regiment on their way to garrison Doublehorned Hill met the Commander-in-Chief who enquired their mission. On learning this he replied: "Why so many of you? One company is enough there; the other may rest." So one company only at first took post on this hill—the key to the central position. The account given of the preparations made by the Japanese for the attack of Doublehorned Hill is very instructive (pp. 279—281). The Japanese storming force, according to this account, outnumbered the Russians five times.

The Western Force had been ordered to take up the line occupied on October 10th by its advanced guards. The Xth Corps was on the Shi-li ho, the XVIIth Corps in and about the village of Yen-tao-niu-lu.

The bulk of Oku's IInd Army attacked the latter: a notable counter-attack delivered by the 9th (Ingermanland) Regiment is described on p. 250. Eventually the Russians were driven back. They determined to retake the village by night assault. Four battalions under Colonel Martinov stormed the village in the dark, and routed the surprised Japanese (pp. 253 and 254). The Japanese attack on Shi-li ho Village was repulsed largely by the fire of a battery which had made by day

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adequate preparations for night firing, a good example of the value of artillery at night (p. 254).

On October 11th the initiative definitely passed over to the Japanese; the Russian offensive was spent, and their further action for the remaining days of fighting was restricted to warding off the blows of their enemy.

Chapter VIII.—During the night of October 11th—12th the Japanese prepared for further offensive operations against the Russian Centre and Western Forces. General Kuropatkin had great cause to be anxious lest his centre should be penetrated, and his right flank turned. He endeavoured to reinforce the centre, using General Stakelberg's reserve, IInd Siberian Corps; and he ordered General Bilderling to retire, an order which led to some misunderstanding and confusion. The IVth Siberian Corps offered an obstinate resistance in the centre, but had to give ground by the end of the day; and the XVIIth Corps was driven back across the Sha ho. The Eastern Force, discouraged by the failure of its night attacks, and alarmed for its left flank by the appearance of Prince Kanin's 2nd Cavalry Brigade, also began a retrograde movement. This chapter is rich in tactical lessons, in particular, attention may be drawn to the description of the Japanese attack on Shi-li ho Village (p. 307).

Chapter IX.—A long appreciation of the situation on the evening of October 12th shows that the collapse and retreat of the XVIIth Corps was not then known at General Headquarters; it refers to a Japanese "demonstration" against the right of the Western Force. By this time, if General Kuropatkin had been kept adequately informed as to the situation of his own troops, it should have been evident that Oku's attack was no mere demonstration. We see that General Stakelberg, who also was unaware of the defeat of the XVIIth Corps, intended at first to hold his ground. He was, however, anxious for his flanks, and had just cause for uncertainty as to how he stood for reserves. By the Commander-in-Chief's orders his IInd Siberian Corps in the space of a few hours had been withdrawn, restored and again diverted to assist the Centre. But about 1 p.m. the order for retreat was received from General Headquarters. This gave Stakelberg the first news that the XVIIth Corps had been forced back to the Sha ho. He was now directed to withdraw the Eastern Force northwards, to keep touch with the rest of the army and protect its left flank.

A Russian success of importance was achieved on the Chao-hsien Ling by Colonel Lisovski's detachment (Ist Siberian Corps) which encountered and stopped a brigade (Matsunaga's) sent by Kuroki to cut off the retreat of the Eastern Force. The narrative then proceeds with the arrangements made to withdraw the Eastern Force to near Pien-niu-lu-pu.

The Western Force was now behind entrenchments. The XVIIth Corps, north of the Sha ho, spent October 13th in restoring order. Fortunately for General Bilderling the Japanese were not active here, and the fighting was confined mainly to the artillery. The VIth Siberian Corps was definitely allotted to General Bilderling on this day.

A heroic battle raged in the centre about La-ta-shan, and the troops under Generals Mau, Zarubaev (IVth Siberian Corps) and Mishchenko suffered very heavy losses. Here is an example of the fighting (p. 359). For four hours a part of Mishchenko's force withstood a determined attack by Kuroki's troops (1st Guard Division). So heavy were the losses that in the half-company alongside the general only five men remained in the ranks. Ammunition ran short, and one company met the assault with stones and cold steel; six boxes of ammunition were brought up at the critical moment, firing was resumed, the assault was repulsed, and the Japanese dead lay within 16 paces of the trenches. At nightfall the Russians fell back.

No decisive events occurred on this day. The historian considers that the Japanese now appreciated the dangerous situation of the Eastern Force if the Russian Centre was broken, and henceforward applied all their efforts to this task.

Chapter X.—On October 14th the Eastern Force continued its retreat with little molestation and came into line with the rest of the Army behind the Sha ho. General Kuropatkin now withdrew the Ist Siberian Corps from Stakelberg's command. In the centre, General Mishchenko and the 1st Army Corps were heavily engaged, and for several hours the last-named corps was in a precarious position as the Russian

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troops on both flanks had fallen back. A remarkable confusion of orders is recorded on p. 933; the 37th Division (Ist Army Corps) received simultaneously orders to attack and to retire; to solve the difficulty the division did neither, but stood fast. The principal action of the day concerned the Xth Corps about Houtai, south of the Sha ho. The Xth Corps had been worried for most of the night, and at dawn on October 14th the Japanese stormed Kan-chia-la-tzu, a village on the Mandarin Road, and drove in the centre troops of the corps. So impetuously was the attack followed up that the Japanese captured three batteries which only became aware when too late that the enemy were close upon them (p. 369). Later in the day the Xth Corps attempted to recover ground, but their attack failed and the Corps was withdrawn to the north bank of the Sha ho. The Western Force engaged in serious fighting at La-ma-tun and Lin-shin-pu, and the latter place was lost. A well-delivered counter-attack took place at Ta Ling Tun, on the right of the XVIIth Army Corps. Here the Russians gallantly recaptured some of their guns. General Kuropatkin had intended Bilderling to keep the VIth Siberian Corps in reserve, but it was brought up into the front line at 7 a.m. and directed to advance to the Sha ho. Although the tactics adopted led to heavy loss and to no direct success, yet it relieved the pressure on the XVIIth Army Corps and enabled them to hold La-ma-tun and the ground generally.

Chapter XI.—The events of October 15th are told in only sixteen pages. The Eastern Force, all of which was now on the north bank of the Sha ho, engaged in no serious action. In the centre General Kuropatkin was at work collecting a general reserve. He ordered General Stakelberg to send him 24 battalions, and collected 24 more from the Ist Corps and IVth Siberian Corps. With these troops the Commander-in-Chief contemplated the delivery of a counterstroke from the right centre, but circumstances prevented the accomplishment of this design. The Xth Corps threw up new entrenchments behind the Sha ho, astride of the Mandarin Road. The XVIIth Corps endeavoured without success to recover ground at Lin-shin-pu, and lost La-ma-tun. The loss of La-ma-tun may largely be attributed to the effort to form a corps reserve by withdrawing battalions from the front line. The neglect to inform adjacent troops of what was going on led them to think that a general retirement was in progress, and so the troops in La-ma-tun fell back unnecessarily (pp. 407, 408). On this day it became evident to the Russians that the Japanese offensive was weakening.

Chapter XII.—To those wearied of the long tale of Russian hesitation and failures, this chapter will bring a sense of relief. The narrative of the night attack and recapture of Putilov and One Tree Hills provides a brilliant episode in a monotonous record of ill success. Just where the Mandarin Road crosses the Sha ho, that river makes a northerly bend which encloses a little group now known as Putilov and One Tree (or Novogorod) Hills. From these eminences the Russian position could be enfiladed, and General Kuropatkin decided that they must be retaken. Pp. 435 to 442 and *Plate* 46 describe the operations. An artillery preparation from well-concealed batteries commenced at 3 p.m. on October 16th, and 25 battalions in two columns were to deliver an enveloping attack at 6 p.m. The left column became prematurely committed to the attack; but, in spite of the difficulties entailed in fording the river and advancing for over a mile in the dark, the Russian right column approached unopposed to within 400 yards of the Japanese trenches, and then carried them at the point of the bayonet. Sixteen guns were taken and Putilov Hill was secured. Between 9 and 10 p.m. One Tree Hill was also captured, but the difficulties of intercommunication were such that the captors were unable to hold it owing to the fire from their own infantry, and the Japanese regained possession though only to be ejected finally at 3 a.m. on October 17th. The capture of Putilov Hill marked the conclusion of the Sha ho operations, which, according to the Russian view, ended indecisively.

Chapter XIII. is devoted to the miscellaneous work carried out on the Russian lines of communication in the immediate theatre of operations.

The arteries of supply were extremely varied. The Western Force depended upon the main line of railway, although the bridge over the Hun ho, partially destroyed by the Russians during their retreat from Liao-yang, had first to be repaired. The

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Eastern Force was supplied by the Fushun Colliery branch line, which was in such bad condition that traffic on it was restricted to a speed of 6 miles an hour. Junks on the Liao ho and Hun ho carried stores and food for Kossakovski's and Dembovski's detachments. Field tramways could not be used as most of the material had been lost or scattered during the retreat. Nor did uniformity prevail in regard to transport. Army transport vehicles and hired Chinese carts were commonly used, but General Rennenkampf had pack transport, and Colonel Madritov was given a free hand in furnishing his detachment with both food and transport from local resources. The Army of Manchuria had little cause to grumble at the inflow of its food supplies. The maintenance of ammunition stocks does not appear to have been so successful, and great anxiety prevailed lest the reserves at the front should be totally exhausted. The extraordinary efforts made to get a special train load of ammunition through from Kharbin to Mukden are related on pp. 464 to 466.

After dealing with road construction and telegraphs (12 bridges were provided over the Hun ho besides the railway bridge), the chapter concludes with the evacuation of the sick. The plight of the wounded was indeed pitiable; brought from the battlefield to the railway mainly in springless transport vehicles, they were loaded into trains of every description, without any sorting out, and passed on to Kharbin. Out of 45 train loads—30,701 men—sent off between October 14th and 25th, only 11 were proper hospital trains. There was great lack of medical *personnel*. The resources of Kharbin were unequal to the situation. Trains were kept as long as three days before they were off loaded. The station roads were congested and covered with blood-stained bandages and filth indescribable. Baked bread was unprocurable, hot food could only be provided for one meal in the day. Such was the picture in the rear 330 miles from the field of battle.

The special measures necessary to cope with the wholesale leakage of able-bodied men from the ranks on the pretext of detached duty in the rear are of interest (p. 472). Many hundreds of men fit for duty found on the trains were systematically collected, and escorted again to the front.

The Appendices, 49 in number, consist of orders, instructions, memoranda, reports, and telegrams bearing on the operations, but too diffuse to be included bodily in the narrative.

The order of battle, and composition of the Army of Manchuria just prior to the Battle of the Sha ho constitute Appendices 47 and 49 respectively. The "Notes" occupy only six pages, of which three are devoted to Colonel Martinov's explanations in justification of his action in evacuating La-ma-tun.

The maps are the disappointing feature of the volume; they are poorly printed, and of all sorts of shapes and sizes. Those which illustrate the operations as a whole are so crowded with names and detail as to be almost unreadable. The larger scale maps illustrating particular incidents in the fighting leave little to be desired.

The narrative of the fighting on the Sha ho presented in this volume is necessarily compiled almost entirely from Russian sources of information, it therefore gives in most cases only one side of the story, and the picture presented lacks the perspective and breadth of view which should be obtained by judicious blending of the several experiences of the opposing forces.

The 23 officers who collaborated under the French General Staff in translating this history from the Russian original may well be congratulated on the result of their labour. The French edition is easy to read, clearly expressed, and free from the stilted style which so often pervades a translation.

PART II.—The Second Part of Volume IV. relates the story of the winter period of the campaign, after the Battle of the Sha ho, and the events leading up to and culminating in the Battle of Sandepu. It contains also in a supplement the narrative of General Mishchenko's raid on Ying-kou. The chapter headings are as follows:—

Chapter XIV.—Situation of the opposing sides after the Sha ho operations during the winter.
Chapter XV.—Strengthening the positions.
Chapter XVI.—Plans of operation prepared during the winter.
Chapter XVII.—Operations during the winter lull.

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The Battle of Sandepu.

Chapter XVIII.—Elaboration of the plan of operations.
Chapter XIX.—Deployment of the IInd Manchurian Army. Preparation of the operations.
Chapter XX.—Assumption of the offensive. Battle of 25th January, 1905.
Chapter XXI.—Operations of January 26th.
Chapter XXII.—Operations of January 27th.
Chapter XXIII.—Operations of January 28th. Retreat of the IInd Manchurian Army. Fighting at Chang-tan-ho-nan.
Chapter XXIV.—Organization of the immediate rear after the Battle of the Sha ho.

Supplement.—General Mishchenko's Raid.

Chapter I.—Preparation for the raid: description of the country.
Chapter II.—Operations of the cavalry up to Ying-kou station.
Chapter III.—The attack on Ying-kou station. The return of the cavalry.

Chapter XIV.—The Russian historian attributes the failures of the Sha ho operations to the almost total absence of local reserves, as well as to the insufficiency of the General Reserve; and he points to the success which ensued at Putilov Hill on October 17th after the General Reserve had been formed afresh on the previous day (p. 12).

This success inspired in General Kuropatkin a desire to renew the offensive at the end of October, and General Bilderling also put forward a scheme. But these plans did not fructify. Both sides were wearied, weakened, and short of ammunition; and although sniping was incessant, and skirmishes occurred frequently, the opponents devoted themselves during the remainder of the year to entrenching their ground and reorganizing their formations. The wastage in the Russian Army had been great: battalions were reduced to 400 men, and the deficiency in officers was serious. On October 24th General Kuropatkin addressed a long telegram to the Tsar asking for more troops. The divided responsibility for command, which had hitherto existed between the Viceroy and the Commander-in-Chief, was now removed, and General Kuropatkin was given full powers on October 26th. Reinforcements were arriving rapidly, and on November 10th the troops in South Manchuria were organized into three groups, the Ist, IInd, and IIIrd Manchurian Armies, respectively, under Generals Linievich, Bilderling, and Kaulbars. Still, by the end of November the units at the front were only up to 75 per cent. of their establishment, and drafts amounting to 50,000 men needed to complete them to war strength were only due to arrive by the end of December.

The new formations asked for were expected in January, 1905. The chapter concludes by describing the difficulties which arose during the winter. Prolonged rains in Northern Manchuria had hindered the collection of supplies at Kharbin, and various circumstances had combined to hinder the expected increase in the traffic capacity of the Siberian and Chinese Eastern Railways. The troops required warm clothing, felt boots, and tools. The Chinese authorities had been obstructive and Chinese transport drivers had proved unreliable and had to be replaced by Russian soldiers. But these difficulties had all been met by January 15th, 1905.

Chapter XV.—At the opening of this chapter a general sketch is given of the entrenched lines within which the armies lay throughout the winter. The trenches made originally during the Sha ho operations were constantly improved and added to, until they grew into an almost continuous belt of fortifications extending for 33 miles in which were interspersed—fortuitously—redoubts, lunettes, and villages in a state of defence. The effect of this was to chain the troops to their trenches and greatly to discourage offensive operations; indeed, even small reconnoitring parties often had much difficulty on their return to find the narrow gaps available in the lines of obstacles. Moreover, movement was attended with danger and difficulty in rear owing to fougasses and obstacles which had been allowed there. The IIIrd Manchurian Army had two lines of defence—not with a view to greater security, but on account of vacillation as to which of two positions should be occupied in the

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event of the Japanese resorting to the offensive (p. 49). Units took duty in the trenches in reliefs for periods of two to four weeks. Constant sniping prevailed. Food, fuel, and water could only be brought up at night. Niches were dug in the reverse slopes of the trenches for the use of men and officers, and stoves were provided for making tea. Local reserves sheltered in ditches with lean-to overhead cover. The reserves were more comfortable in dug-out hutments for 30 to 50 men warmed with stoves, and fitted with plank beds.

The Japanese were considered to be very strong in the centre—about the Mandarin Road. Page 60 gives their estimated numbers as 180,000 bayonets, but it was uncertain whether the 8th Division was present. Three lines of defence were said to exist between Liao-yang and the Sha ho; there were few closed works and the Japanese relied largely on high wire entanglements as obstacles.

The situation in rear of the Japanese armies, as then known, is described on pp. 61—65, in view of the raids which ensued. The lines of communication were weakly protected by quite small posts for about 200 miles between Dalny and Liao-yang.

Chapter XVI.—In this chapter the various plans for resuming the offensive put forward by army commanders, and by the staff at General Headquarters, are examined at great length. The intention to resume the offensive existed with General Kuropatkin from October 15th when the Russian attack on Putilov Hill was crowned with success; but action was postponed owing to the reduced numbers of the units, the shortage of ammunition, and the general exhaustion of the troops. The VIIIth Corps was due to arrive towards the end of November, and it was decided to wait for this, as well as for drafts to fill up the gaps in the units already present. With the arrival of the VIIIth Corps, the Russians would have seven corps in the fighting line and three in reserve. But Kuropatkin's intentions to move in December were frustrated by the failure of the Chinese Eastern Railway to do what had been expected of it. Not only were drafts in arrear, but the troops had not then been properly equipped with the warm clothing and entrenching tools necessary for an advance. On November 25th the Commander-in-Chief telegraphed to the Tsar that he considered it essential to have superiority in numbers, and he proposed to take the offensive in January without waiting for the XVIth Corps and the three rifle brigades.

On December 17th General Kuropatkin circulated an appreciation of the situation to the three commanders of armies and requested their opinions. They all considered that the main blow should be directed against the Japanese left flank, and the plan eventually adopted was based on their recommendations. The plan is given in detail on pp. 102 to 104. Briefly, the Ist Army had to stand fast on the left, the IIIrd Army was to advance in the centre, and the IInd Army would make the turning movement from the right. Elaborate arrangements were projected for deceiving the enemy. Dummy artillery was to be used freely; local contracts were to be given out for food and forage to be delivered in the area of the Ist Army, and troops were to be moved to the east by day and taken back to the west again at night. But on January 2nd, 1905, Port Arthur fell and the situation was changed. Nogi's Army thus released would be on the Sha ho in February, more reinforcements from Russia could hardly be expected in view of the political situation in Europe. "It therefore seemed necessary to take advantage of the transient situation favourable to us, in S. Manchuria and to strive to win a decisive victory." Three rifle brigades and the XVIth Corps were on their way to the front. "It was considered not expedient further to delay the assumption of the offensive by waiting for the 25th Division (of XVIth Corps) but to act immediately the three rifle brigades arrived." The final impetus to action was the realization that if the Russians waited longer the Japanese would themselves take the offensive. Although this chapter contains much that is of interest, it ends with disappointment, for "all the various plans elaborated during the winter lull were only partly put into operation when the advance of the IInd Army ended in the Battle of Sandepu."

Chapter XVII. opens with a general sketch of the fighting which took place from the end of October to the middle of January. It was limited with a few exceptions to unimportant skirmishes, minor raids, and small reconnaissances in force. In the latter the Russians seem to have shown more activity than their opponents, and considered that they served to keep up a cheerful spirit among the troops. Of the

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larger operations the defence of Temple Hill by Colonel Popovich Lipovat is worthy of note. A detachment of about four companies of infantry occupied this advanced position on October 17th and entrenched it during the night. The colonel repeatedly represented the necessity of artillery for the defence of the position, but his requests were ignored; and after holding it for nine days under almost continuous artillery and rifle fire, and withstanding for 10 hours the Japanese assault on October 27th, the battered Russians withdrew in good order.

On November 23rd the Russians carried out an extended reconnaissance along their whole front, with the object of seizing prisoners in order to ascertain the units of the troops opposing them. A moonlight night was purposely selected to facilitate movement, and to this the failure is mainly attributed. Only 11 Japanese were taken, and the Russians lost 80 men killed or wounded. On the following day the Japanese retaliated by attacking General Rennenkampf's force on the east; the attacks were repeated daily until finally repulsed on November 28th. General Linevich wished to follow up the success by sending Rennenkampf to the Tai-tzu ho, but the Commander-in-Chief would not sanction this enterprise.

Chapter XVIII.—Under the sub-headings "Influence of the Preceding Events," and "Influence of Port Arthur," this chapter repeats a great deal that has been explained earlier in the volume. The remainder of the chapter deals with preparation of the final plans for the advance. The circular memoranda and instructions issued from General Headquarters were exceedingly voluminous. On December 21st General Kuropatkin circulated his own scheme for taking the offensive, and invited the commanders of armies to express their views. All favoured the attack on the Japanese left, but Bilderling wished to wait for the arrival of the XVIth Corps and the three rifle brigades.

On December 31st another circular was issued in which the Commander-in-Chief announced his intention to attack as soon as the XVIth Corps began to arrive. The fall of Port Arthur altered the aspect of affairs; an immediate advance became necessary, viz., to forestall the reinforcement of Oyama's armies by that of General Nogi.

Meanwhile, on January 9th, with a view to delaying the arrival of Japanese reinforcements, General Mishchenko had been sent with some 7,500 mounted troops to raid the enemy's communications. He had returned on January 16th without having achieved any tangible result.

On January 19th General Kuropatkin issued his final plan. The immediate objective in this was the envelopment of the Japanese IInd Army (Oku); the ultimate object was to drive the Japanese behind the Tai-tzu ho. The advance was to begin on January 25th. Minute details were entered into as to the tactics to be employed. Information regarding the enemy formed the subject of separate instructions, and in these the movement of the IInd Manchurian Army was restricted. An appreciation of the probable plans of the enemy, given on p. 190, indicated that the fall of Port Arthur was expected, and that the Japanese might take the offensive after the middle of January. The Japanese forces on the Sha ho had been assessed at 260,000 men on January 4th; but shortly before the advance started information came in which showed that the previous estimates were excessive. It is interesting to notice that the Japanese on their part greatly underestimated the strength of the troops on the Russian right (p. 202). The end of the chapter relates the situation of both sides in the middle of January. The general dispositions of the Japanese had altered little since October. Kuroki's Army was on the east, Nodzu's occupied the centre, and Oku's Army on the west extended from the railway to the Liao ho. "The whole Japanese front was a maze of barbed wire"; their lines consisted of trenches and defended villages with only a few redoubts.

Chapter XIX. describes the preliminary operations leading up to the battle. The deployment of the IInd Manchurian Army proceeded very deliberately, and the historian considers that "success depended upon surprise, but the early advance of the various units of the IInd Manchurian Army, and its gradual deployment, undoubtedly disclosed to the enemy the real meaning of our concentration." The precautions ordered to prevent leakage of information are detailed on p. 211. A continuous outpost line was placed. The preparations made in forming magazines

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and laying down branch railways and tramways are given here. The arrangements for intercommunication were elaborate; telegraphs, telephones, and relays were to be provided. Reports were to be rendered every two hours. The instructions included headings under which information was to be furnished; one item being "a list of trophies captured from the enemy." Communication between General Headquarters and the staffs of armies was maintained largely by specially detailed officers of the General Staff. The troops were ordered to carry 250 rounds of ammunition per man. The last part of the chapter gives a description of the country and of its tactical features. The ground was generally level, and favoured the defensive. The locality was thickly populated, the villages easily defensible. Roads were in good order; troops could only move with difficulty across the furrowed fields, and transport not at all. The weather was misty and bitterly cold, the night temperature 20° F. The ground was as hard as iron.

Chapter XX. narrates the first stage in the Russian advance. During the previous week two incidents occurred to disturb the arrangements. On January 18th the Japanese attacked General Rennenkampf's force on the eastern flank; and two days later General Mishchenko on the west reported that a hostile column of 2,500 infantry and mounted troops was moving north-west on to the Liao ho. The latter news in particular caused anxiety, and General Kuropatkin personally directed Grippenberg to put off the offensive for two days, while Mishchenko, reinforced by the 14th Division should fall upon this column. Grippenberg, however, ignored this order, and among the reasons which he gave for so doing is the following remarkable equivocation:—

"When the Commander-in-Chief at our private interview ordered me to put off the advance until the 27th January, he did not cancel his previous written orders to advance on the 25th January."

General Grippenberg issued his orders on January 23rd (see Appendix 40), and on January 24th he informed the Commander-in-Chief that he would advance at dawn next day without waiting for the 14th Division. The Japanese move was only a feint, and the 14th Division after three days' fruitless marching rejoined the VIIIth Corps on the morning of the advance. A description is given of the positions of both combatants just prior to the advance. The IInd Manchurian Army had Mishchenko's and Kossakovski's mounted troops on the extreme right, next came the Ist Siberian Corps. The VIIIth Corps was in the centre, and the Xth Corps on the left. The Provisional Rifle Corps was in the rear on the Hun ho as a reserve. General Grippenberg's intention was to turn the left of Oku's Army by seizing the positions which lay between the Hun ho and the Sha ho, beginning from the Hun ho. The elaborate orders to regulate the employment of the artillery are given on p. 262. The artillery of the IIIrd Manchurian Army was to support the advance of the IInd Manchurian Army. The Ist Siberian Corps was to cross the Hun ho, seize Hei-kou-tai, and then co-operate in the attack of Sandepu. The VIIIth Corps ordered to attack Sandepu was only to proceed when Hei-kou-tai had fallen. The *rôle* of the Xth Corps was to demonstrate only, and its artillery was to support the VIIIth Corps. The narrative then relates the experiences of each corps in turn, and this procedure is repeated in all the subsequent chapters describing the fighting. The Ist Siberian Corps moved off about midnight January 24th—25th: the outpost villages were soon taken, but Hei-kou-tai was obstinately defended and was not captured until 10 p.m. The attack on Sandepu by the VIIIth Corps, delayed until dusk, was disjointed and unsuccessful in spite of bombardment all day long by the combined artillery. The Xth Corps turned the Japanese advanced troops out of the nearest villages, but this display of initiative alarmed the Commander-in-Chief, who telegraphed to the corps commander: "I have told General Grippenberg that the Xth Corps will not advance, please understand this order is to be strictly adhered to." An account of the Japanese operations, taken from Japanese sources, shows that the troops in the neighbourhood of Sandepu consisted mainly of cavalry—8 squadrons, 3 companies of infantry, 6 guns, and 6 machine guns.

Chapter XXI. deals with the third day of the battle. General Grippenberg's orders for January 27th directed that the advance was to be continued, the objective remaining unaltered. The VIIIth Corps was to capture Sandepu, and then send on

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the 15th Division to seize the villages behind that place. Again General Kuropatkin disapproved of his subordinate's intentions; he informed General Grippenberg that it was "inadvisable that the IInd Manchurian Army should undertake decisive operations all along the front," and requested him to limit himself to taking Sandepu. Thus, the historian says: "we see that the operations of January 26th had commenced with a certain disagreement between the Commander-in-Chief and the commander of the IInd Manchurian Army." The Russians were unfortunate in their weather; in two parts of the field, troops went astray in the fog and falling snow. General Lesh's detachment of the 1st Siberian Corps, which had been sent to co-operate with the VIIIth Corps by attacking Sandepu from the south, lost its way and became engaged elsewhere. The VIIIth Corps moved off to the attack in a blizzard and went astray; direction was eventually regained, but the general attack by the 14th Division only developed about 4 p.m., and two regiments got out into the south side of Sandepu. This division, which had just made two forced marches, had been on outpost duty on January 24th—25th, and then in action all day, was exhausted. The men fell asleep in the ranks and lay in the snow. The commander asked that his division should be relieved. To crown all the Japanese set fire to the part of the village which they had relinquished. It was impossible to hold the ground which had been won, and at 2 a.m. the Russians fell back unnoticed by the enemy. The temporary success however was magnified, and the false news that Sandepu had been captured spread with far-reaching results.

A very lengthy explanation of the circumstances involving the evacuation of the captured portion of Sandepu is given on pp. 315 to 333. The chapter ends with General Grippenberg's plans for continuing the attack on the next day, and with a short description of the actions of the Japanese, whose troops in Sandepu had received a timely reinforcement about 7 p.m. on January 26th.

Chapter XXII.—The Battle of Sandepu furnishes a striking example of the confusion which may ensue from meagre and faulty information in the progress of operations. Generals Kuropatkin and Grippenberg both thought at first that Sandepu was taken, and their respective orders issued under this impression had to be altered, with corresponding effects all down the chain of command. At 8 a.m. on January 27th, General Grippenberg decided to continue the attack on Sandepu. But the previous orders had led to a partial dispersal of the artillery required to prepare and support the attack. These guns had to be assembled afresh, and in fact no further attack on Sandepu ensued on this day, and the IInd Manchurian Army was kept inactive.

As the VIIIth Corps was exhausted, General Grippenberg at 8 a.m. ordered the Provisional Rifle Corps to take up the attack on Sandepu; but the day was frittered away, and at 5 p.m. Grippenberg informed Kuropatkin that he proposed to deliver the attack "to-morrow." The feature of January 27th was the remarkable initiative displayed by General Stakelberg in handling the Ist Siberian Corps. He decided to seize Su-ma-pu (a village 5 miles south-west of Sandepu) and met with vigorous resistance; a deadlock ensued. Grippenberg sent a general officer to ascertain the situation, and to impress on Stakelberg that "he must refrain from the offensive and act defensively." The latter sent back the spirited reply that "it was essential to capture Su-ma-pu in order to retain hold of Hei-kou-tai"; and added: "the spirit of the troops is splendid, they themselves desire to finish with Su-ma-pu by a night assault." He persisted with his intentions, and gained the southern end of the village at 4 a.m. on January 27th—28th, but after a desperate struggle his troops were forced to relinquish their hold. General Kuropatkin was much displeased at Stakelberg's enterprise; he was already anxious lest the Japanese should be concentrating about Sandepu with a view to counter-attack. General Mishchenko also engaged in an active offensive on January 27th, and was wounded. The Ist and IInd Manchurian Armies were entirely passive throughout the day.

Chapter XXIII. relates at great length how the Russians came to abandon the offensive and withdrew to their former winter quarters.

On the morning of January 28th, the continuation of the attack on Sandepu was still Grippenberg's main objective; and the Provisional Rifle Corps was preparing to carry this out. But at 8 a.m. the Japanese themselves attacked this corps in

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force; this attack was driven off, but it had far-reaching results. General Grippenberg now proposed to hold the enemy in front and to attack both his flanks, and the Provisional Rifle Corps was told to make no advance without special orders. The Xth Corps, on the Russian left, was directed to attack, but hardly had it moved forward when the corps commander received another order to be ready to resort to the defensive. General Headquarters were alarmed lest the Japanese should be about to fall upon the IIIrd Manchurian Army—the Russian Centre. The Ist Siberian Corps was again heavily engaged. General Stakelberg fell back from Su-ma-pu, and at 2 p.m. the Japanese made an attempt to get into Hei-kou-tai. This failed, but the attack was repeated at intervals in the dark, and culminated in a general assault at midnight. The Russians held their ground.

General Grippenberg's plans for January 29th are discussed on p. 401. He still proposed to revert to the offensive on that day, and assembled a conference to draw up a plan for the attack on Sandepu, but, says the historian: "Sandepu had lost its former significance in consequence of the necessity of first defeating the enemy's active troops."

An important section of this chapter is devoted to: "The Commander-in-Chief's orders directing the offensive movement to cease." Throughout the day the Commander-in-Chief's anxiety lest the Japanese should be preparing a coup grew more and more acute, and at 8 p.m. on January 28th he telegraphed to General Grippenberg's Chief of Staff: "Withdraw forthwith from the advanced line . . . the troops will fall back to-night." A confirming telegram said: "An advance of a considerable force of Japanese upon the IIIrd Manchurian Army has been discovered. It is necessary for a time to abandon the capture of Sandepu. The IInd Manchurian Army will concentrate on the left bank of the Hun ho, and take up a line for an obstinate defence." And so once more General Kuropatkin gave up the initiative.

The narrative then deals with the withdrawal of the several corps to the positions allotted to them; the measures taken by the IIIrd Manchurian Army to meet the expected attack, and the action of the Chan-hun-ho-nan from January 31st to February 1st. This village had been seized by the Japanese early on January 29th. The 4th East Siberian Rifle Regiment was sent to retake it, but could make no headway owing to the havoc wrought by the enemy's machine guns. After a night attack a footing was gained on February 1st, and the Japanese were finally ejected next day. The account of the main operations taken from Japanese sources shows that on January 28th the Japanese main objective was Hei-kou-tai.

The story of General Grippenberg's recall to Russia is given on p. 418. On January 30th he telegraphed direct to the Tsar asking to be recalled on account of ill-health, and on His Majesty demanding "the real reasons for your request," General Grippenberg replied: ". . . Apart from my health, the real cause which compels me to request to be relieved of the command of the IInd Manchurian Army is that I have been completely deprived of the initiative and independence which is my right, and also because of the painfulness of the situation resulting from the impossibility of doing useful work for our cause, which is in such a miserable state." And certainly the Commander of the IInd Manchurian Army had ample grounds for complaint in these respects. The chapter concludes with statistics of losses during the operations.

Chapter XXIV. deals with the organization of all the administrative services at the front during the winter of 1904—1905. The matters dealt with include supply, transport, railways, roads, telegraphs, ammunition and ordnance, medical and sanitary services. The arrangements made to house the drafts, amounting to some 40,000 men, in the vicinity of Mukden are of interest. Large numbers were quartered in the Chinese villages, a rent of from 1 to 3 roubles per night being paid for each house occupied.

Extensive use was made of horse tramways to facilitate supply. The preparations made to supply food and forage for Mishchenko's raid are given on p. 461. The attempts to keep the matter secret were not very successful, as transport was hired for the supplies and of course the contractors had to be informed as to their destination.

The Appendices consist of various reports, states, orders and telegrams *in extenso*.

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No. 5, a telegram dated January 2nd, 1905, from General Kuropatkin to the Minister of War, gives a very good idea of the natural difficulties with which the troops had to contend. No. 11, a telegram dated December 28th, 1904, reveals the deficiencies in clothing, tools, supplies, etc., in the Manchurian armies. This telegram is also remarkable for its length: it occupies more than six pages of print—about 2,500 words. Nos. 23 and 24, a memorandum and a report by General Linevich, discuss the proposed offensive operations. No. 28 gives the minutes of the conference held on January 10th, 1905, at General Grippenberg's Headquarters to consider the plan to be adopted in the offensive. No. 34 is the order of battle of the Russian forces in Manchuria on January 14th, 1905. No. 40 contains General Grippenberg's Orders of January 11th, 1905. The notes are unimportant. The maps showing the situation generally suffer from lack of clearness. The largest scale maps are good.

THE RAID ON YING-KOU BY THE CAVALRY DETACHMENT UNDER GENERAL MISHCHENKO.

Chapter I.—The first part of the chapter deals with the situation of the Russian cavalry after the Sha ho, and with several proposals to employ it actively. On December 24th General Kuropatkin ordered Mishchenko to examine the country south of the Liao ho as soon as the rivers froze, and recommended that the reconnaissance should be carried out by parties of 25 to 50 men. A week later Port Arthur capitulated and it became very important to delay the transfer of Nogi's Army to Liao-yang. A scheme to dispatch the cavalry to the south of Hai-cheng was under consideration at General Headquarters, and on January 4th General Kuropatkin himself suggested that Ying-kou should be raided by a force under Mishchenko to consist of 12 cavalry and Cossack regiments, 6 batteries of horse artillery, and pack transport.

General Mishchenko rendered a report (Appendix No. I.) on January 5th, in which he proposed that his force should march on Ying-kou and Ta-shi-chao, the distance to Ying-kou being 80 miles. He proposed to move in three columns on a narrow front. Three days' forage and five days' rations were to be carried by the transport, as well as two days' rations on each man. The transport convoy was to consist of 1,500 pack animals, besides 600 pack horses in regimental transport. Ammunition was to be carried in carts. This scheme was adopted generally, and the Commander-in-Chief's instructions to Mishchenko form Appendix No. 2. A mixed force was formed under General Korsakovski to assist the raiding cavalry to return. The latter part of the chapter describes the country over which the raid was to travel. It consisted of a plain, mainly of black soil, well cultivated and closely populated along the river banks. The rivers could be crossed on the ice, but their steep banks often required preparation. Water was not easy to obtain. The country generally was suited for cavalry action, and capable of supporting the troops engaged in the raid. The fears that the locality had been drained of its resources proved unfounded. The season was favourable and the weather clear.

Chapter II. narrates the start and progress of the raid from 8th to 11th January. The whole force comprised 71 squadrons (or sotnias) and 22 guns, a fighting strength of 7,000 to 7,500 men. The instructions for the march constitute Appendix No. 5. Fighting *en route* was to be avoided. General Samsonov objected from the outset to the presence of transport and desired to trust to the country, but was over-ruled by Mishchenko. General Mishchenko divided his force into three columns—Right, Centre and Left—under Generals Abramov, Samsonov, and Teleshev, respectively. The concentration of Si-fan-tai was covered by the IInd Manchurian Army. The fighting troops marched off at 3 p.m. on January 8th and covered about 20 miles that evening. On January 9th the columns crossed the Liao ho, and marching only at a walk bivouacked at Davan 23 miles further south. The transport moved out of Si-fan-tai on January 9th, and at once got into difficulties. The animals were ill-broken and fractious. They were led in strings of five, the loads constantly came off, mules lay down, the column strung out, the speed attained was only 1½ miles per hour, and bivouac was reached only at 10 p.m. Mishchenko ordered half the loads to be distributed to the troops, who having found ample supplies on route did not require any more.

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On January 10th the columns marched towards Niu-chuang. Three mixed sotnias were organized for the demolition of large bridges on the railway. One sent to the north of Hai-cheng first lost its way, then stalked up to a snowdrift in mistake for a bridge, and, failing finally to find a bridge, blew up the line in several places. Another partly wrecked a train. No important railway structures were destroyed, and the damage actually was repaired in six hours. It is said that these parties covered 120 miles in 22 hours. The right and centre columns became engaged with two companies and some hostile cavalry at Ka-li-ho. Two officers were killed, one a volunteer from the French Army. The transport again hindered Abramov's column. The troops bivouacked 20 miles further south after 18 hours in the saddle.

Increased precautions were deemed necessary on January 11th. The Tai-tzu ho was crossed at noon, and the Japanese troops in Niu-chuang evacuated that place. Demolition parties sent to the railway north and south of Tai-shi-chao effected only trifling damage. "The transport continued greatly to delay the movement of the force" (General Abramov's diary). The force bivouacked between Niu-chuang and Ying-kou after a march of 21 miles. About 550 carts with supplies for the enemy had been captured.

Chapter III.—The raid culminated in an attack on Ying-kou Station on January 12th, and the first part of this chapter described this locality. The railway village had been put into a state of defence, and was covered by a rampart whose exterior slopes had been watered to render it unclimbable. The surrounding marshy ground presented a field of ice giving no foothold. Mishchenko's information as to the strength of the garrison was conflicting, but it appears to have been about 1,300 men. The orders for the attack are given in Appendix No. 10. A detachment was sent 5 miles east to cut the railway and stop reinforcements reaching Ying-kou, and another detachment was employed to deliver a feint attack from the east. The greater part of the force was kept in reserve. The real assault was to be delivered from the north only after a prolonged bombardment, and nineteen squadrons from various regiments were placed under Colonel Khoranov for this task. They carried twelve pack loads of guncotton and a quantity of kerosene. The artillery soon set fire to the stores in Ying-kou, and at 6 p.m. Mishchenko sent orders to Khoranov: "There is no one in the station, attack at once and destroy everything there." The attackers very soon got into difficulties on the smooth ice; and, being illuminated by the glare from the burning stores, came under heavy fire. No progress could be made, and at 7.40 p.m. Khoranov gave orders to withdraw. Nothing had been achieved, and he had lost 61 men killed and 232 wounded or missing. Mishchenko now decided to fall back to the army; his reasons are given on p. 85. The retirement began on the morning of January 13th. The force was hampered with wounded, and so could only travel at a walk. Thaw had commenced on the Liao ho, and the thin ice was crossed with difficulty. On January 14th Japanese infantry from Niu-chuang began to cross the Liao ho, but were checked by artillery fire; in the fighting which ensued the Russians lost 48 men killed and wounded. At one time General Teleshev's column lost touch, and Mishchenko was preparing to turn back to his aid when news came in that he was coming along. During the day the force marched 19 miles. No further fighting occurred. The raiding force joined hands with Korsakovski's troops on January 15th, and was broken up on the 19th.

The results of the raid are summarized at the end of the chapter. The raiding force covered 167 miles in 8 days. The damage it effected was insignificant, and the force lost 365 officers and men killed and wounded. At the end of the raid the troop horses were in fair condition and capable of fresh work. The transport was in a sorry plight: 327 animals had been lost, 458 were in a bad state, and the equipment was ruined. Only 36 per cent. of the supplies carried had reached the troops. General Mishchenko attributes this collapse to the carelessness of the *personnel*, "who did not trouble to feed or even water the animals," and says in his report: "The transport was a useless encumbrance."

Appendices Nos. 6, 7, 8 and 9 contain the orders for the raiding force from 8th to 11th January. Appendix No. 11 gives the orders for retreat. The maps which deal with the raid are clear.

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NAVAL AND MILITARY ESSAYS: BEING PAPERS READ IN THE NAVAL AND MILITARY SECTION AT THE INTERNATIONAL CONGRESS OF HISTORICAL STUDIES, 1913. 243 pp. 8vo. Cambridge, 1914. University Press. 7s. 6d.

The naval essays consist of the following:—Historians and Naval History, by Sir J. K. Laughton; Staff Histories, by J. S. Corbett; Naval History from the Naval Officer's Point of View, by Capt. H. W. Richmond; Samuel Pepys as a Naval Official, by J. R. Tanner; Naval History and the Necessity of a Catalogue of Sources, by Lieut. A. Dewar.

The military essays are: The Difficulties Encountered in Compiling Military History, by Colonel Sir Lonsdale Hale; The Value of the Study of Military History as Training for Command in War, by Lieut.-Colonel F. B. Maurice; The Practical Application of Military History, by Lieut.-Colonel N. Malcolm; Précis of the Plans of Napoleon for the Autumn Campaign of 1813, by J. Holland Rose; The Influence of Tactical Ideas on Warfare, by L. S. Amery; Field Marshal Prince Schwarzenberg, a Character Sketch by Dr. J. F. Novák; A Defence of Military History, by Prof. C. W. C. Oman; Foreign Regiments in the British Service, 1793—1815, by C. T. Atkinson.

This is an admirable ollapodrida, which from the variety of its contents should find many readers. In the naval section, "Pepys as a Naval Official," is an essay which will appeal to everybody. The amiable Samuel once wrote, we are told, an official minute to the effect that "Englishmen, and more especially seamen, love their bellies above anything else" (Dr. Johnson made a remark to very much the same effect), and, acting on this text, he appears to have done splendid work to the end that the Navy should be punctually supplied with good victuals. He preached a crusade against drunkenness in the Navy, supplied it with chaplains whose "piety, learning and conformity" were above suspicion, and, generally speaking, he remains a model to the Civil Service for all time, though of course it should hastily be added that this applies to his public, not his private, life, as disclosed in the delightful diary. In the military section, Colonel Sir Lonsdale Hale's "Difficulties encountered in compiling Military History" is of great interest. Writing of the German Official Account of the Franco-German War of 1870–71 he says, "It is a marvellous example of *suppresio veri* from beginning to end. Go through that book and you will seek almost in vain, in this history of the actions of human beings like ourselves in stress and difficulty, for any record whatever of anyone in the German force having made a mistake or done anything he should not have done, and yet this book is military history." Mr. Corbett, in his "Staff Histories" in the naval section, makes a remark to very much the same effect: "They labour under two drawbacks. One is, that frankness about political and other external deflections is not entirely possible, since the time has not come when such matters can be laid openly upon the table. The other that, since they are written in the lifetime of the men who fought them, there is a tendency to modify criticism." Prof. Oman, in the concluding paper, "A Defence of Military History," rightly takes the late J. R. Green to task for his amazing statement in his "History of the English People," that "the only war which has profoundly affected English society and English government is the Hundred Years' War with France (1336—1451)."

All these Naval and Military Essays, from which the above are but a few random extracts, are of very great interest. The book forms part of the "Cambridge Naval and Military Series," of which it is to be hoped many more volumes will be published.

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R.E. WORK AT THE FRONT.

We are greatly indebted to Officers of the Corps at the Front for sending reports of the following important R.E. work. Such information is especially valuable at the present moment. We shall gladly welcome any further communications.

(A). REPAIR OF OLD BRIDGE AT ——.

On September 27th one section of the —— Field Company, R.E., was sent to ——.

A design was sent in for the repair of the Old Bridge at —— by using wooden lattice-work girders. The bridge consisted of several stone arches, and one large span of iron girders at the south-west end of the bridge. The demolition had been done by the —— in retiring, and a gap of 76 ft. in the clear was left. The height from the roadway to the bottom of the river was 40 ft., so that an intermediate support was almost out of the question. The bridge was designed to take a maximum concentrated load of 10 tons, and four girders were used with thick chesses laid flat on top. The design was accepted, and orders to begin work were received at mid-day on September 30th. The section had been at work the previous night, and only three hours' work was therefore done on the afternoon of September 30th, which consisted chiefly of collecting nails, spikes, bolts, etc., and sorting the timber required for the whole of the work. After this, the work was carried on from daylight to dark, *i.e.* from 6 a.m. to 6 p.m. each day, with one hour off for dinners. The next day, October 1st, one girder was constructed near the bridge under cover behind a row of houses. The enemy shelled the river occasionally with shrapnel throughout the day. The first girder was tested on the afternoon of October 1st ; it was packed up at both ends and a platform constructed in the middle, and on this, men to the weight of 2 tons were placed. The girder deflected $\frac{7}{8}$ in. and rose $\frac{1}{2}$ in. when the weight was removed. After this it sank or rose $\frac{1}{2}$ in. each time it was loaded or off loaded.

The next day, October 2nd, two more girders were constructed. The enemy had now practically ceased to shell the river. That night footings were cut for the girders on the centre pier ; these consisted of holes about a foot deep, and measuring about 7 in. wide and 10 in. high cut into the face of the stone to receive the ends of the bottom flanges. Charges were also fixed and fired at 3 a.m., to cut off the ends of the broken girder, that would otherwise

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have been in the way. On October 3rd two girders were tested with 7 tons dead concentrated load. The deflection was 1 in. and the girder rose this amount on being off loaded. The fourth girder was then finished and a platform on trestles built up on the towpath to support the girders at the shore end. Shear legs were constructed and everything prepared for launching the girders.

On October 5th we stood by, waiting to hear if the German guns had moved, as our girders would have been a splendid target for them, and would soon have been demolished. Late on October 5th the —— General Commanding the —— Army Corps informed us that the girders could safely be launched, and the work was begun that night and continued and finished on October 6th. They were pushed up to the bridge on rollers. They were then held vertical by side guys and pulled across the gap with a 2½-in. fall and tackle attached to shear legs on the centre pier. The girders weighed about 2 tons and the working party only numbered 28, so that great care had to be taken, especially as the girders had very little lateral strength. The cross-bracing between the girders was commenced the next day, October 7th. It consisted of lateral bracing under all four girders, and between the top flanges of the centre girders. The roadway was spiked on at the same time and consisted simply of 7-in. × 2½-in. deals, laid on top of all four girders; this made a 12-ft. roadway with wheel guides 8 ft. apart to keep the vehicles over the girders. The bridge was completed except for the handrails and a few details, by 6 p.m. that night. When heavy vehicles passed over the bridge it trembled slightly but did not sway. The handrail was finished on the morning of October 8th.

The total working time taken was 61 hours, exclusive of the time taken to finish off the handrail.

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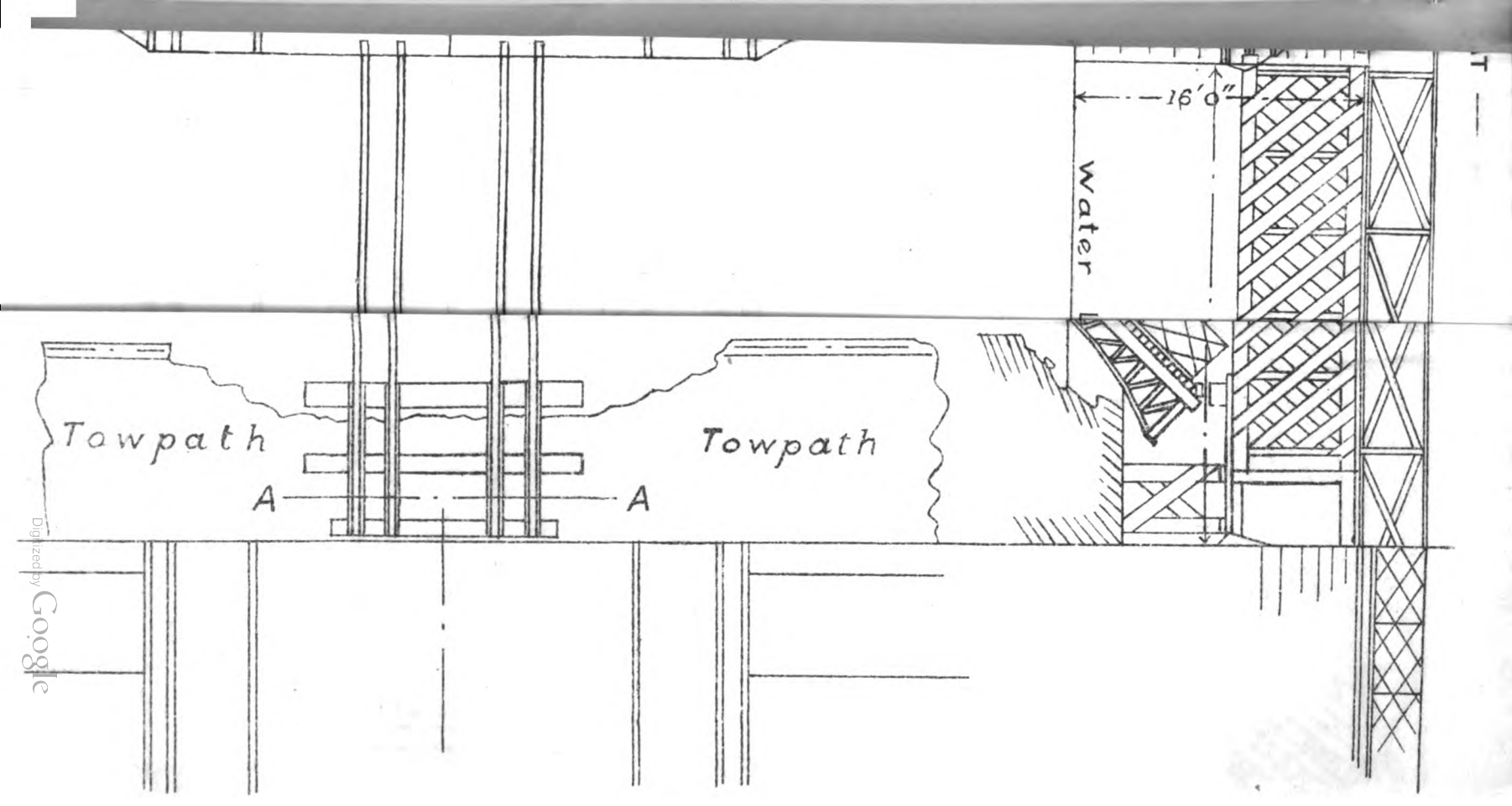

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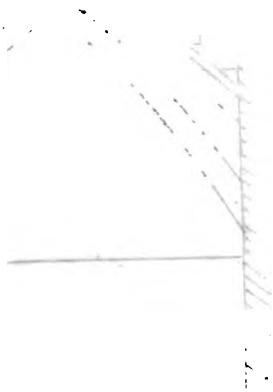

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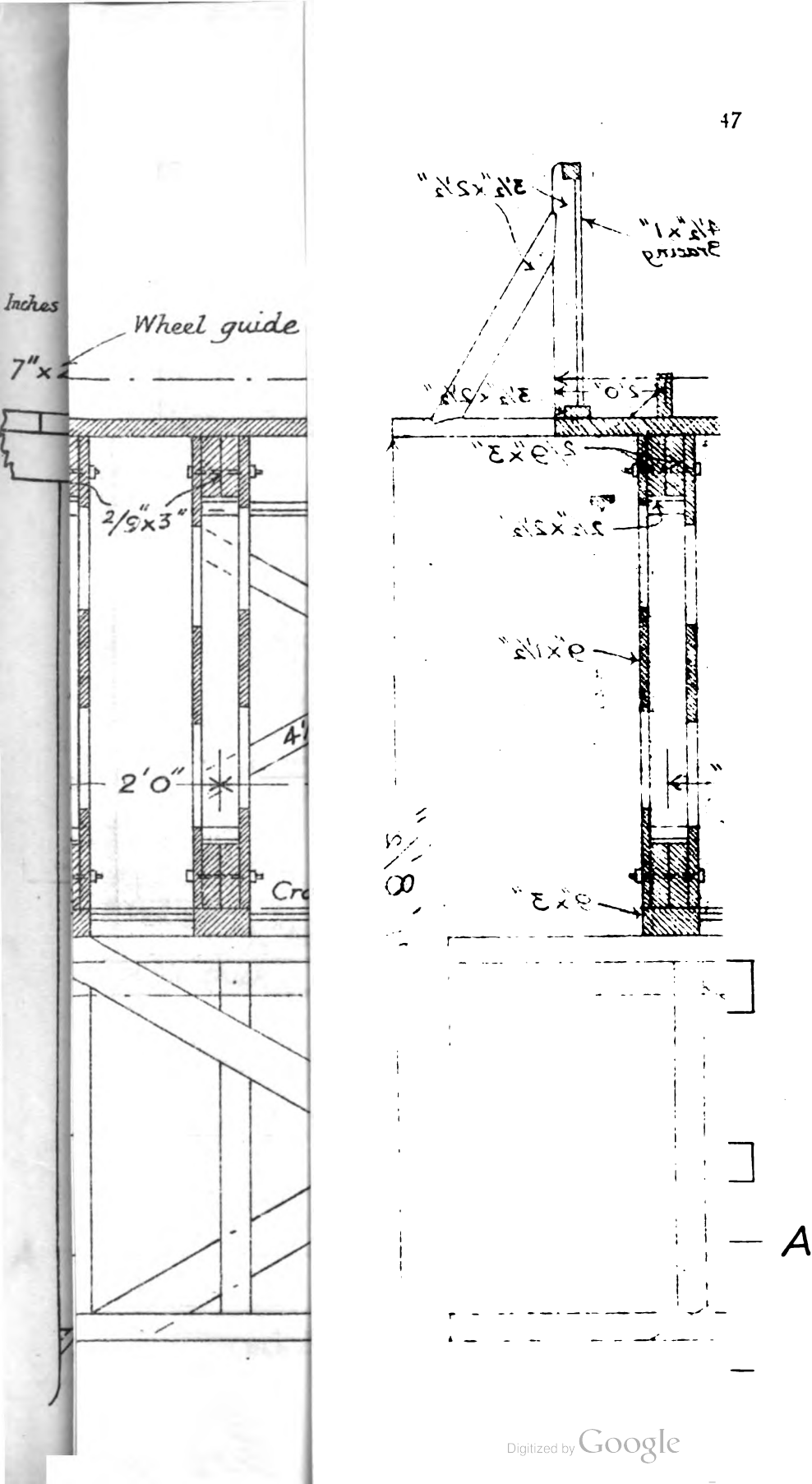

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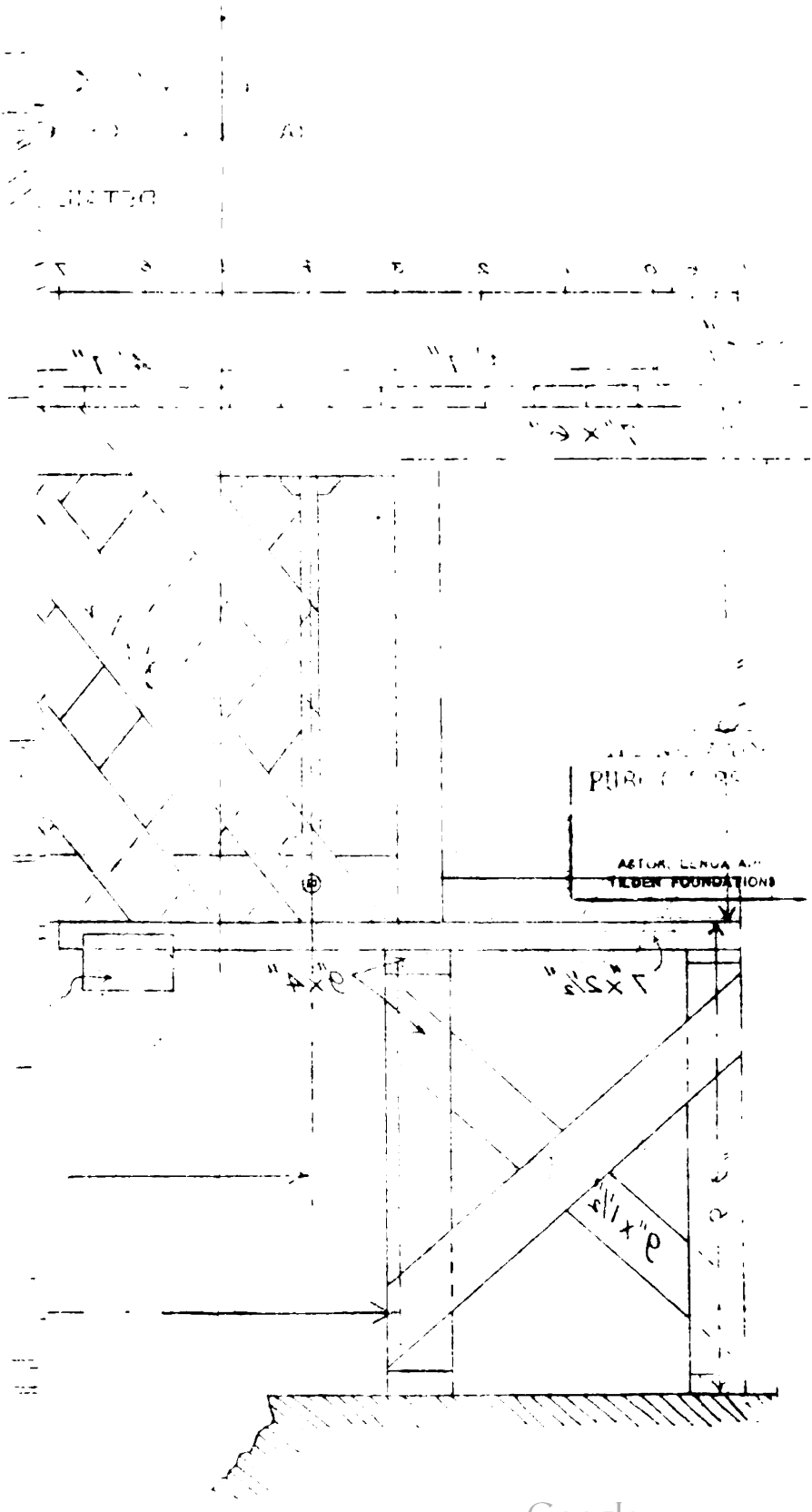

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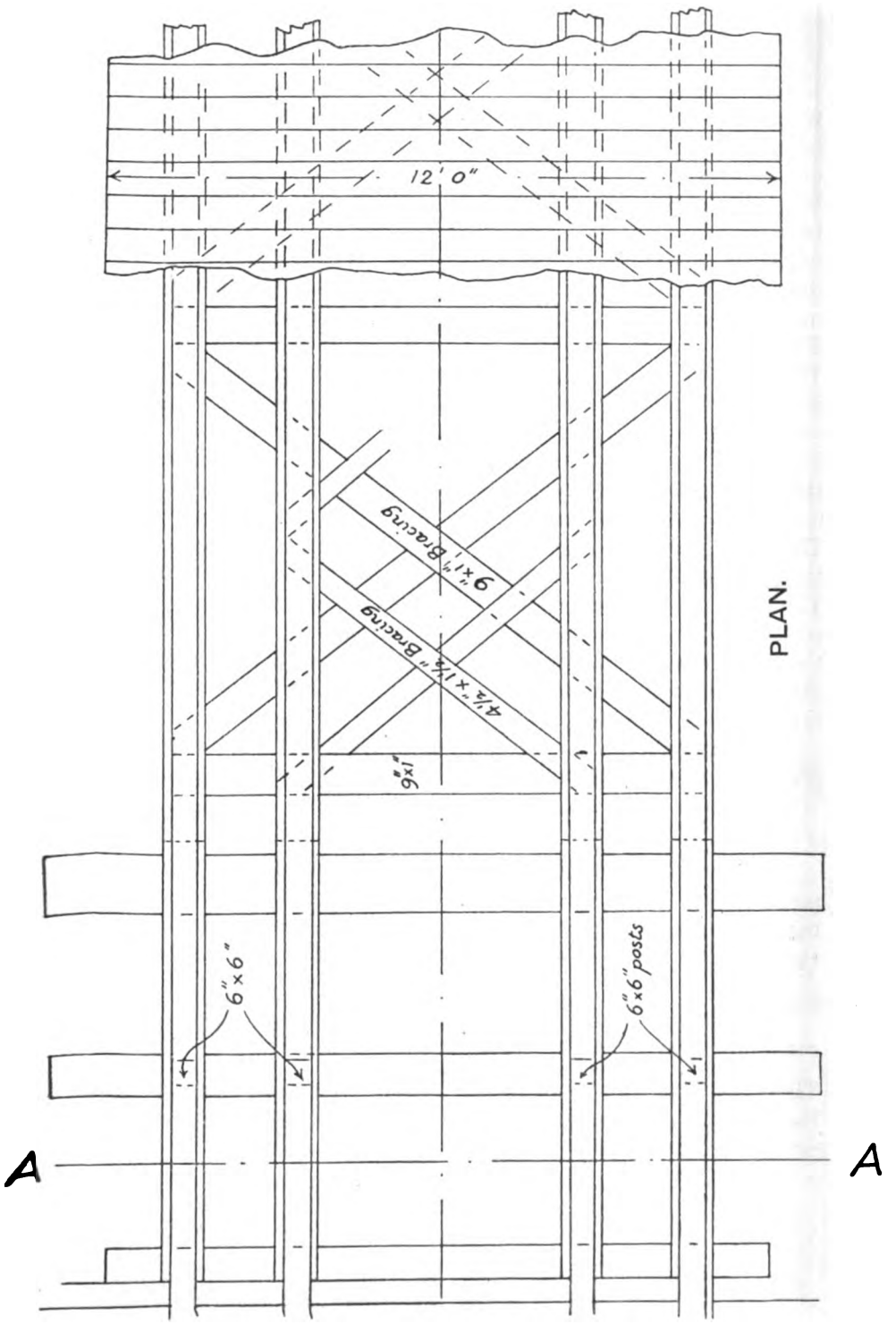
(A). REPAIR OF OLD BRIDGE AT ——



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(B). BRIDGE AT ——.

The bridge at —— over the —— consisted of two 7-ft. iron girders with a central support on a masonry pier, the spans on either side being 90 ft. When the —— Division arrived at —— they found that an attempt had been made to cut these girders at a point 30 ft. from the south end of the bridge; every flange and all the web had been cut except the lower flange on the west side of the bridge, where the charge had failed. The charge consisted of tonite and was detached, and dropped into the river. The bridge was now held up by one flange and the roadway which was reinforced concrete. The infantry crossed in file, and the bridge swayed considerably. The —— Company, R.E., then placed some wedge-shaped stones in the break of both compression flanges, and as the weight came on the bridge the jagged edges of the flanges held these stones firmly and so helped to stiffen the bridge, which was now able to take the field guns which were manhandled over. The next step was to repair the broken tension flange on the east side of the bridge. This was done by tying together two transverse girders with 1-in. tie bars which encircled these girders and were screwed up tight. Three of these ties were used. The wedge-shaped stones were then replaced with channel irons $2\frac{1}{2}$ in. $\times$ 1 in. $\times \frac{1}{4}$ in. which were bolted together through the flanges and cut to such a length that they fitted tight between two stiffeners, as shown in the sketch. The bridge was now able to take all traffic.

In order to further strengthen the bridge rivets were then cut and plates bolted on across the break on all the flanges.

CALCULATIONS.

Assuming that the girder was capable of supporting itself in the position in which it was found, the repairs required were such as to make it strong enough to take say 6 tons live *concentrated* load over the bridge. The maximum bending moment in this case would be $6 \times 1\frac{1}{2} \times \frac{30 \times 60}{90}$ ft.-tons, and the M. of R. is $T \times 6$ where T is the maximum stress in the flanges. Hence $T = \frac{9 \times 30 \times 60}{90 \times 6} = 30$ tons. Therefore about 4 square inches of steel should be provided across the break in each flange. In practice about twice this amount was provided.

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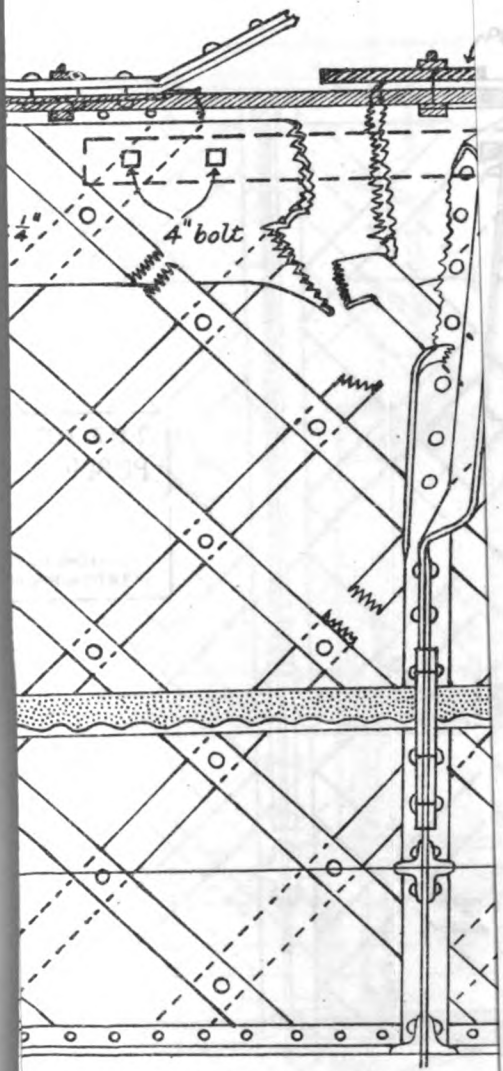
WEST GIRDER.



Sectional Elevation on Line A-A.
(See Section).

Scale—$\frac{3}{4}'' = 1'$.

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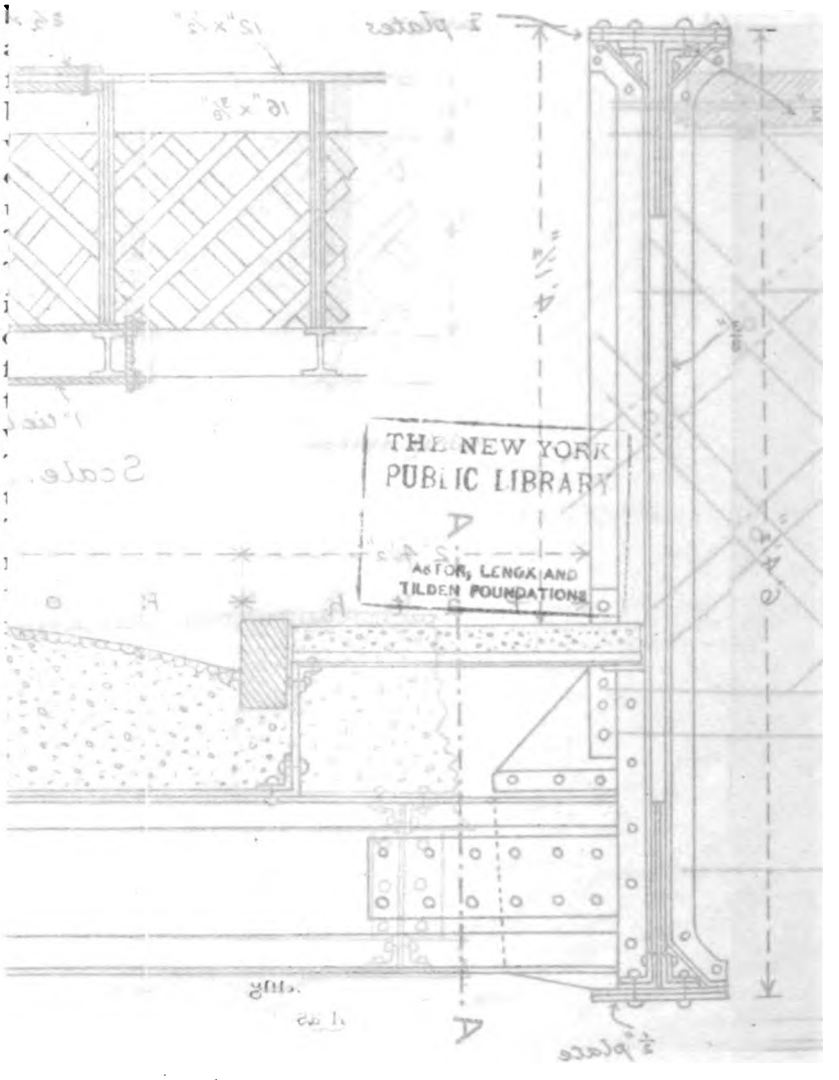
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PLANE TABLES AND FIELD SHEETS.

By CAPT. H. ST. J. L. WINTERBOTHAM, R.E.

IN August, 1914, there appeared an interesting paper on the subject of mounting drawing paper on plane tables by Capt. R. H. Phillimore, R.E. The distortion of the " field section " or " field sheet " due to changes of humidity and temperature has been a thorn in the side of the topographer for many years, neither does there appear to be any means of eliminating it as long as paper, linen backed, is mounted upon a wooden board. Some papers do give much better results than others. Messrs. Mallandain & Co., King's House, King Street, London, E.C., supply a linen-backed paper which has been found to give fairly satisfactory results. Distortion is due, however, not only to the unequal expansion of the paper, but to the unequal absorption of moisture by the paste, and to differences of expansion in the wood, with and against the grain.

The solution of the problem given by Capt. R. H. Phillimore is ingenious and the results of the first year's experience will be most interesting.

An adaptation of the same idea was tried during a topographical training on the Ordnance Survey in 1913. Bristol boards slightly smaller in area than the plane table were attached by corner clips which were kept loose enough to allow free play for expansion, except when the plane tabler was actually at work. This system was found to answer fairly well, despite a few cases of " cockling," and made possible the transfer of the Bristol board from the topographer's board to that of the reviser.

In a systematic topographical survey this latter is a great advantage ; for it renders unnecessary the number of boards which must otherwise be carried, and enables the plotting of trigonometrical points to be done as long before the detail as may be expedient.

Bristol boards, however, although they generally show no distortion if they are free to move, yet do expand. For reproduction this would not be serious, but for the comparison of mutual edges it remains a drawback. Moreover a Bristol board increases the weight. In view of these two objections experiments were made in 1913 with linen-backed paper mounted on aluminium or zinc. The co-efficients of expansion of both these metals are so small as to be negligible for any ordinary range of temperature.

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The points which were aimed at in the production of a mounted field sheet were :—

1. The elimination of distortion and the reduction of expansion as far as possible.

2. Permanency—so that the finished field sheet should constitute a reliable record of the work done.

3. Adaptability to any of the special plane tables designed for it.

4. Lightness.

The two metals have about equal claims under 1, 2, and 3, but aluminium is much the lighter, and its slightly larger cost (8d. as against 4d.) is negligible in comparison to the value of the finished field sheet. Aluminium was therefore chosen. It was at first thought that the actual field work could be done upon a grained aluminium plate, and the experiment was tried. It was not altogether unsuccessful, but the general conclusion come to was that the use of the aluminium surface for field work should be discontinued because

1. It is easily destroyed by dirt, sweat, and rubbed out by pencil.

2. The metal becomes hot to work upon in warm weather.

3. The metal is not easily secured to the table.

Paper can be secured firmly to grained aluminium and the combination remains sensibly constant for normal ranges of temperature, but it was found that the edges curled up enough to interfere with the sight rule.

It became necessary therefore to strain the field sheet down upon the table by springs, or lashings, and this was simplified by fixing linen on the aluminium with overlaps projecting beyond all four edges. The paper was then mounted on the linen. Field sheets so constructed have proved satisfactory.

The weight of this field sheet is about 1 lb. more than that of linen-backed paper of sufficient size to mount the board. In some surveys this extra 1 lb. would be a handicap and it seemed possible to save it in the weight of the board. Thirty-gauge aluminium is sufficiently stiff to stand drawing, and the weights of the Indian clinometer and alidade, if it is supported at intervals. A skeleton board was therefore made, and proved to answer very well. It is described on page 116 of the *Text Book of Topographical Surveying*.

The first design was somewhat elaborate, however, and during the first trainings of 1914 experiments have been made to find a simpler pattern. That which proved most satisfactory is described below.

The field sheet is laid on the board ready for fixing and the board is viewed from below.

AA strips of aluminium mounted in the edge of the overlaps of linen and with holes at intervals to fit the BB fixed hooks and CC spring hooks fixed in the depth of the scantling of the skeleton top.

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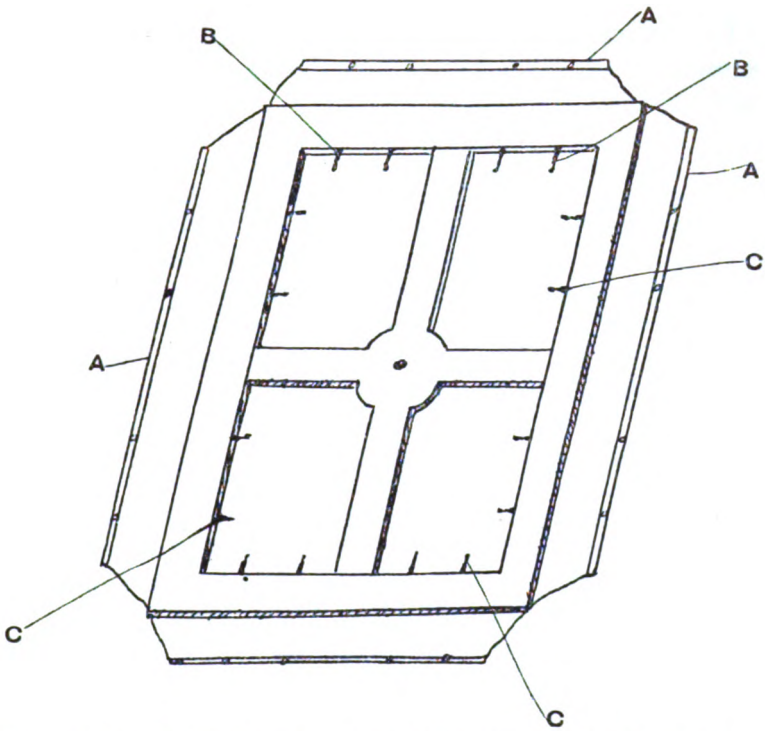

The weight of this board mounted is compared with that of the plane table, R.E., mounted with linen-backed paper, and a Bristol board, respectively, in the following table :—

Description. Size 24 in. × 18 in.	Total Weight.
New board and aluminium field sheet ..	4 lbs. 7½ ozs.
Plane-table, R.E., board with linen-backed paper	4 lbs. 12½ ozs.
Plane-table, R.E., board with Bristol board ..	5 lbs. ½ oz.

The pattern of board described above can be fitted to the legs now in use for the "plane table, R.E." There are however no arrangements for a slow motion in azimuth on these legs. Indeed the feeling of many topographers is averse to the introduction of anything which can be considered elaborate. In those countries where most of our plane-table work is done breakdowns may be fatal. Experiment has proved, however, that a simple but ingenious arrangement can be fitted to the existing pattern of legs which provides a slow motion, thrown in or out of action by a cam, and detachable at will. It has been tried this year and unanimously approved of.

Another small modification which has proved valuable is the introduction of one collapsible leg for each table. They are quite stiff when clamped, add little to the weight, and enable the table to be levelled on steep ground without undue splay of the legs. As each leg is detachable and is generally packed separate from

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the "top" the inclusion of a small number of legs of this pattern in the survey outfit will not necessitate their use if found undesirable, but will provide for a possible want.

In the table of weights and prices given below the new type of board is called type A, and the same applies to a set of three legs with slow motion in azimuth and one collapsible leg.

It occasionally happens that topographical work has to be based upon a graphic triangulation, or that the two are done concurrently. In these cases the board has generally to be bigger, and a telescope alidade used with it. For work of this nature a special plane table has been tried with a board of 24-in. square. The field sheet and board are designed on the same principle as described above, but made stronger to support the additional weight of the telescopic alidade. The board is levelled by a ball and socket joint made of aeromin. The importance for graphic triangulation of a field sheet which will maintain its size, not only relatively, but almost absolutely, is self-evident. Experimental work with it has been satisfactory, but trainings this year have been so much interrupted that its use has necessarily been restricted.

In the table of weights and prices this board is referred to as type B.

TABLE OF RELATIVE WEIGHTS AND PRICES.

Description of Table, etc.	Weight.	Price. £ s. d.	Remarks.
Plane table, R.E., complete (without cover)	10 lbs. 12½ ozs.	2 8 10	Priced vocabulary of stores, Part 1.
Type A board with legs of plane table, R.E.	9 lbs. 7½ ozs.	3 0 0 (*a*). 2 17 6 (*b*).	According to quantity— quoted by Messrs. Watts & Son, 123, Camberwell Road, London.
Type A board and legs	11 lbs. 2½ ozs.	3 15 0 (*a*). 3 12 6 (*b*).	
Type B	12 lbs. 8½ ozs	5 12 0 (*a*). 5 7 6 (*b*).	

In conjunction with type A table a new sight rule was tried. The Service pattern is of boxwood. The edges of this pattern are apt to get chipped and broken and in hot and dry climates it warps. Moreover a parallel ruler attachment is of great help to the topographer, as it does away with the necessity of rotation round a fixed point. The new sight rule was of duralumin, and weighed exactly the same as the Service pattern (1 lb. 1½ ozs. in the case). It has a parallel ruler attached and can of course be inscribed with any scale and title. A couple of small level bubbles at right angles to each other can be added and help the initial levelling of the table. Messrs. Watts & Son make it (inclusive of leather case) at a cost of from £2 15s. to £2 12s. 6d. depending on quantity.

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SIEGES AND THE DEFENCE OF FORTIFIED PLACES BY THE BRITISH AND INDIAN ARMIES IN THE XIXth CENTURY.

(*Continued*).

By COLONEL SIR EDWARD T. THACKERAY, V.C., K.C.B. (LATE R.E.).

THE SIEGE OF SEBASTOPOL (*continued*).

Vice-Admiral Korniloff was an able administrator and thoroughly understood the duties of a naval commander; but was not gifted with the faculty of designing apt plans for the conduct of the war.

But if the army was wanting in this the time of trial, there had come to Sebastopol, as a guest, a man so gifted by nature as to be able to fill the void; and able moreover to make people bend to his judgment, confessing that his was the guidance which would best meet the emergency; yet, curiously enough, until some four or five weeks before the time of the landing of the Allies, the name of Lieut.-Colonel de Todleben had scarcely been heard of in Sebastopol.

Colonel de Todleben was born in one of the Baltic provinces lying within the dominions of Russia, and to Russia accordingly he had ever devoted himself, but by race, and name, and feature, and warlike quality he was the fellow-countryman of Count Bismarck.

The honour of placing this gifted man on the scene in which he was destined to achieve his renown, must be given to Prince Michael Gortschakoff. Having discovered the capacity of Colonel de Todleben, and knowing how likely it was that the issue of the conflict, which he perceived to be impending, might be governed by a skilful application of the engineer's resources, Prince Gortschakoff determined that he would not only entrust to the colonel the duty of conveying his warnings to the headquarters in the Crimea, but would introduce him to Prince Mentschikoff as an officer capable of being of great use to him in the business of fortification.

Colonel de Todleben was master of the art of military engineering. His devotion to the study of his profession had been unstinted; and there was a period when his practice of the business of mining had kept him underground during a third part of each year. He had great experience in the trenches before Silistria, and the rough tasks of war in the Caucasus. He was about thirty-seven years old.

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During the three weeks which elapsed between Colonel de Todleben's arrival and the appearance of the armada on the coast, he was not only making himself acquainted with the field of the approaching conflict, but also beginning to earn that rare confidence, which afterwards enabled him to guide into a right direction the valour and strength of the garrison.

It may truly be said of this colonel of Sappers, all that was fanciful or for any reason unpractical—all that lay, though only by a little, beyond the immediate future with which he was dealing—he utterly drove out of his mind, and his energies, concentrated for the time upon some object to which they could be applied with effect, were brought to bear upon it with all their full volume and power. Under guidance so firm and sure there could be no waste of energy and no waste of bodily labour.

When the Russian field army undertook its flank march, Colonel de Todleben remained at Sebastopol. Admiral Korniloff and he had come to be as one man. They lived in the same room. What de Todleben judged to be right, the Admiral impelled men to do. If Korniloff was the soul of the cause, the great engineer was its mind.

On the 24th September, the day the Allies were marching on the Belbec with the then apparent intention of attacking the Star Fort, Korniloff assumed the command of the North Side and Colonel de Todleben, whilst still continuing to direct the works going on there, was now also charged to post the troops in the way he deemed the best for resisting the expected assault.

Korniloff did not seriously imagine that with the comparatively small force of 11,000 men under his command, he would be able to offer a successful resistance to a resolute attack directed against the Star Fort by a victorious army with a strength of between 50,000 and 60,000 men. Colonel de Todleben did not deceive him and he did not deceive himself. "From the North Side there is no retreat," Korniloff said to Capt. Gendre. All of us who are there will also find our graves. Death does not terrify me. Only one thing makes me uneasy. If wounded, one cannot defend one's self, and to be taken prisoner!"

The morning of the 25th brought with it no signs of the expected advance of the Allies against the Star Fort; but as though to add to the helplessness of the people abandoned in Sebastopol, Prince Mentschikoff had left them without the cavalry required for reconnoitring the enemy; and it seems that the garrison remained unacquainted with the momentous operation in which the Allies were that day engaging, until it was almost noon. Then, strange to say, they learnt the truth without seeking it. From the Naval Library which stood upon a high knoll in the town of Sebastopol and commanded a far-reaching view, some officers extended their gaze towards

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a quarter not hitherto thought of as the probable scene of any English or French operations. They looked towards the heights overhanging the head of the roadstead. There, scarlet and glittering under a bright noonday sun, they saw regiments and regiments of the English soldiery moving up along the skirts of the forest to the Mackenzie Heights, and afterwards descending southward into the valley of the Tchernaya. All day, the march was seen going on; and before evening, the heights where the English had first been descried were observed to be alive with dark-coated troops moving on in the same line of march which the scarlet battalions had taken. The import of this movement could hardly be doubtful.

It meant that the Allies were abandoning the valley of the Belbec with design to attack Sebastopol on its south side.

It followed that the Severnaya, which before had been regarded as doomed, was now safe, and that the danger had all at once, shifted from the north to the south of the place.

On the south, the now threatened side, the seamen were commanded by Admiral Nachimoff. Of these for the moment there were few; for out of the battalions already withdrawn from the ships, no less than eleven were on the North Side, and of land forces there were none except the Militia battalions. Nachimoff was a brave, devoted man; but the courage he now evinced was of that forlorn sort which consists of blank despair. By cutting apertures in the ship's sides—to be filled up until the last moment by stoppers—he strove to ensure to himself the power of sending his whole squadron to the bottom with little delay.

Vice-Admiral Korniloff continued to be the "Chief of the Staff" of the Black Sea fleet, and remained in command of his naval squadron; but independently of these functions, the Prince entrusted to Korniloff the command of all the forces, both naval and military, which were to operate on the North Side.

Entrusted with the command of the North Side at the moment when that was the ground believed to be in peril, Korniloff after Lord Raglan's flank march, saw that owing to the Allies so plainly committing themselves to the enterprise of attacking the South Side, the North for the time was comparatively safe.

Korniloff had so much greatness of mind, and was of so generous a nature, that despite the straitening effect of the formalism then predominant in Russia, he was able to understand the occasion. The army, and the commander of all the forces both naval and military, had abandoned the place to its fate. The navy was imprisoned. The peril which beset Sebastopol was great and imminent. On the other hand, Korniloff's orders, if only they were to be obeyed, would prevent him from acting upon the scene of the approaching conflict, and rivet him fast to that North Side which was no longer threatened. Far from accepting the repose thus enjoined by his

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instructions, Korniloff at once turned away from the quarter whence the danger had passed, and went straight to where the danger was coming. Giving up the command of the North Side to Capt. Bartenoff, and leaving orders for the transport of his eleven sailor battalions from the North to the South, he went on board the *Twelve Apostles*, in order to consult with Admiral Nachimoff for the defence of the main town and arsenal, now so suddenly threatened; and for the same purpose Korniloff assembled at his lodgings Admiral Nachimoff, General Möller and Colonel de Todleben.

There, arrangements were made for distributing what forces they had along the lines of defence on the South Side. But this was not all that the assembled chiefs did. They came to a great resolve.

Forgetting their mere rank in the army and the navy and remembering only the welfare of their country General Möller and Admiral Nachimoff requested Admiral Korniloff "to undertake the general arrangements for the defence of the town." And Korniloff did not shrink from accepting the command thus proffered him. He observed, it is true, that the land forces would not be under an obligation to obey his orders, but General Möller met this objection by appointing Korniloff the Chief of the Staff of the Sebastopol garrison, and by publishing an instruction which enjoined obedience to all the orders which Korniloff might give the land forces.

The Russians take a just pride in tracing the glory of their defence of Sebastopol to the political courage and the generous self-denial which thus secured unity of command in the gravest hour of danger. Having forbidden the scuttling of the ships as proposed by Admiral Nachimoff, Korniloff with Todleben at his side, devoted his whole energy to the all but desperate purpose of defending the South Side.

The march of the Allies to the south coast was a surprise to the garrison, which had assumed, since the day of the Alma, that the attack would be delivered against the Severnaya, and their energies having been directed in the main to that quarter, they had not found time to do much on the South Side. There, the principal change which had been effected since the landing was the completion of the Central Bastion; and although the lines along the Karabel Suburb were fully equal in their military value to those which took in the main town, they had received but little accession of strength since the day of the landing.

The Battery of the Point had indeed been begun, and preparations had been made for strengthening the position of the Malakoff Tower; but little had hitherto been done to this quarter, and the Malakoff on the 25th September, was a mere naked tower, without a glacis, exposed from head to foot, unsupported by the powerful batteries which were intended to flank it, and uncovered as yet by the works which afterwards closed up round its base.

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There were no intermediate entrenchments along the line of the Karabel Suburb to connect with one another the four works either begun or established. These four works afforded but a weak defence to the great intervals of ground by which they were divided. Upon the whole, it may be said that along the arc of 4 miles which encompassed the place on the land side, the part which reached from the Artillery Bay to the Central Bastion was the only one that could be considered tolerably secure.

All the rest of the line of defence, and all the works of the Karabel Faubourg were weak, and could be easily forced. They afforded hardly any cover for infantry, not even for the reserves; and the gunners at the batteries, having for the most part mere barricades to shelter them or having to serve guns which fired over the parapets, would have been ruinously exposed.

To defend this weak line Korniloff had indeed as many artillerymen as he needed; but it seems that the whole number of other combatants that he could employ in the defence of Sebastopol was only 16,000. In this force there was an imperfect battalion of sappers, and a body of 5,000 Militiamen. The rest consisted of seamen withdrawn from the ships, and had been formed into 16 battalions, of which only four were well trained and well armed. The remaining battalions were but slightly instructed in the duties of the land service, and portions of the force were ill armed, some carrying old flint muskets, and some having no better weapons than pikes or cutlasses.

With 16,000 combatants of this description, it was hopeless to try to defend a line of 4 miles against such an attack as might be made by the victorious army of the Allies; and this the more so, since the garrison, split into two by the Man-of-War Harbour and the deep ravine at its head, would be unable to concentrate upon any one endangered quarter this little strength that it had. In the opinion of de Todleben, it was impossible that the attack of the Allies could be repelled by even the most valiant defence.

The 26th, it is true, passed away without showing that the Allies (who had this day seized Balaklava) were preparing an attack for the morrow; but on the other hand it brought no tidings of the invading army. "Of the Prince," writes Korniloff on this day, "nothing is to be heard."

On the morning of the 27th, the garrison was still without tidings of Prince Mentschikoff and his army. "Thus," so Todleben writes, "the defenders of Sebastopol had no help that they could reckon on. It has been seen that it was absolutely impossible for them to repel the enemy with only the force the garrison consisted of. So there remained to them no alternative but that of seeking to die gloriously at the post committed to their bravery."

A solemn ceremony of the Russian Church was ordered to be held

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along the lines of defence. At an early hour the troops stood ranged in order of battle. Then the priests with images, gonfalons, and crosses, walked in procession along the lines, and performed divine service at each of the bastions, and the troops were sprinkled with holy water. "Let the troops first be reminded of the Word of God," said Korniloff, "and then I will impart to them the word of the Czar."

When the religious ceremony was ended Korniloff made a spirited address to the troops. He said, "The Czar hopes that we shall not give up Sebastopol. Besides we have nowhere to retreat to. We have the sea behind, the enemy in front. Prince Mentschikoff has deceived our enemies and got round them, and when they attack us our army will fall upon their rear. Remember then—believe in no retreat. Let the bands forget to play the retreat! Let him be a traitor who sounds the retreat! And if I myself give the order for retreating, kill me with the bayonet!"

In his addresses to the men of the land service, he added words to this effect: "Your business will be at first to receive the enemy with a well-directed fire of musketry; and if they should try to mount the batteries, receive them in the Russian style. You well know the work—at the point of the bayonet!"

Korniloff's address was received with the sound of bursting "Hurrahs!" which followed him through the lines.

In a work of this kind, it was necessary to give a somewhat lengthy description, although in a condensed form, of the defenders of Sebastopol up to the 28th September, 1854, and to show that the whole bearing of the conduct of the future defence of the place depended upon the resolution and energy of men such as Admiral Korniloff and Colonel de Todleben.

The Siege proper may now be considered to have been entered upon and the details of the operations will be related as far as is possible in the condensed form required by a work of this kind.

Governed as de Todleben was by his conception of two conditions, stress of time on the one hand, and on the other, the command that he had of all the ships' guns and munitions—he went on to frame his plan for strengthening the lines of defence, and with that view resolved "to choose a position as little extended and as near to the town as the nature of the ground would allow, and to arm its principal points with a formidable artillery; to connect these points one with the other by trenches to be defended by musketry; to establish there separate batteries, each armed with some pieces of cannon, and in this way to concentrate upon all the approaches of the town a powerful front and flank fire of artillery and musketry, endeavouring to sweep with as much fire as possible all the bendings of the broken ground by which the enemy might approach."*

* *Todleben*, Vol. I., p. 259.

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The object of the works to be undertaken on this general plan was to provide against the event of an assault at whatever part of the line it might be attempted; but the way in which they were to produce their result was to be by enabling the garrison to meet every column of assault with a slaughtering fire.

de Todleben was always steadfast in declaring that against an assault of the Allies the garrison had but one defence. This lay in the volume of shot which the garrison might be able to pour into bodies of troops coming on within grapeshot range; and one single word, he used to say at the time, was enough to describe his main purpose—"Mitrail!"

The round shot, the shell, the bayonet, and the rifleman's far-ranging bullet had each, he acknowledged, its use; and now too if ever in war, the spade and the pickaxe were needed; but still in his mind, these things were chiefly of worth, because they either tended to avert the assault, or else, were more or less auxiliary and conducing to his one cherished purpose of meeting the assaulting column whatever the time, whatever the point of attack, with a pelting blast of mitrail.

There was also open to the defenders of Sebastopol, another and a more hopeful view of the future. The very sight of preparations for resistance might not only bring the enemy to adopt counter-measures for neutralizing these same preparations, but might even perhaps incline him to delay his attack. It was in fact hoped that the enemy might be induced to refrain from attacking Sebastopol, with a view to besiege it instead. The problem as stated by one who toiled at Korniloff's side* was to maintain a line of 4 miles against powerful armies with only a small body of sailors and militiamen; whilst the way to attempt its solution was by making the defences so formidable as to induce the enemy to forsake the idea of an immediate assault, and proceed to a regular siege.

Besides the task of connecting the still isolated works by intermediate entrenchments, it was necessary to deepen the ditches, to thicken and raise the parapets, to erect traverses, and to strengthen the ground by a great number of new batteries. Also, if only the enemy would give time enough, the armament along the whole line of defence was to be changed, and the lighter artillery replaced by heavy guns brought from the ships. Colonel de Todleben determined that the works should go on simultaneously along all the weak parts of the line; and each day's toil was to be so adjusted that it would not only effect a due approach towards the perfecting, after a time, of the work which had to be executed, but would also bring the impending improvements to such a state every night, that in event of an attack next morning they would still subserve

* Gendre, *Matérieux pour servir*, Chapter III.

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the defence; so that if the enemy should grant a long respite, or if on the other hand he should assail in three days, or in two, or on the very morrow, the works—whether grown to full strength, or assailed whilst yet frail and weak—might in each case do all the good which the limit of time might allow.

And now by the ardour of Korniloff and de Todleben, all things and all people within the place were turned to the business of the defences. There was no ceasing. The people worked by relays. From dawn to sunset, between 5,000 and 6,000 men were busy along the lines of defence. By help of torches, other men, in less numbers, carried on the work through the night.

Colonel de Todleben, it would seem, was instinctively conscious that the power he was wielding depended very much upon his actual presence. He never wrote. He did not even read the communications which poured in upon him; for believing that he saw his way clear without the help of others, and being accustomed as an engineer to let his thoughts take the form of estimates and reckonings, he made as it were a computation, by which he assured himself that the probability of there being important matters in the papers before him, was not great enough to compensate the distraction and expenditure of most precious time which must be occasioned by reading them. It was with his own eyes, with his own voice, that he defended Sebastopol. At a later period when the besiegers could rest their field glasses on the gabions which covered their batteries they grew to be familiar with the aspect of an officer on a black charger, who was constantly seen in the Russian lines of defence; and they more than once pointed their guns with design to extinguish that untiring activity of one man, which (even from across the space which divided the besiegers and besieged) they could perceive to be of value to the garrison. In that ceaselessly diligent horseman, they saw the great volunteer whose brain was defending Sebastopol.

When the morning of the 28th had dawned, it still appeared that the Allies were undertaking no instant attack, but they were afterwards seen reconnoitring the defences of Sebastopol.

On the same day the deserted garrison of Sebastopol got tidings at last from Prince Mentschikoff's Army, and the officers who brought the message also brought news that the Prince had been reinforced by the arrival of 10,000 men under Khoumatoff, and was hourly expecting from the north fresh accessions of strength.

The next day, the 29th, the Allies were seen to be again reconnoitring, but again refraining from an attack, and the people of Sebastopol as well as the garrison were beginning to draw encouragement from the immense improvement that had been effected in the defences by several thousands of men always working by day and by night.

It was at the Malakoff, and the ground which flanked it on either

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side that the greatest wonders had been wrought. Admiral Istomin, who commanded there, knew that the post was vital; but also he had been frankly told by Korniloff that it was weak. He had toiled with a ceaseless care, looking closely into all details, and guiding the labours of the multitude which had swarmed night and day round the work.

That simple white tower, the Malakoff, now famous in history, had been so changed in shape by the industry of the last three days, that it now closed high up round the centre of the building, and had not only begun to take the form of a glacis annexed to the original work, but was also the site of a new semi-circular battery which covered the front of the tower. This last battery was connected by entrenchments with the other new works thrown up on both flanks of the Malakoff. Ships of war were so placed in the creeks that their fire could search the ravines which descended into Sebastopol. To ease the passage between the town and the Karabel Suburb, a floating bridge was constructed, nothing was forgotten, nothing neglected, and on the night of the 29th September, the great engineer who had yearned to be in readiness with his pitiless storm of mitrail, might almost lie down to his rest with the contentment of one who had made his purpose sure.

When morning broke on the 30th September, it showed that the Allies were still abstaining from any attack. This was the sixth of the days which had passed since Prince Mentschikoff's Army had been withdrawn from Sebastopol.

In the course of the day the advanced guard of the Russian Army, commanded by General Jabrokritzky, appeared on the North Side; and the sight of his troopers was most welcome to the garrison and inhabitants of Sebastopol, as they imagined that the field army was returning at last to share in the perils and glory of striving to defend the place. But this joy at the time was ill-founded; for although some of Mentschikoff's troops had thus come once more within sight of Sebastopol, and could freely communicate with the town by crossing the ferry, their presence on the north of the roadstead was still far from really meaning that Prince Mentschikoff had resumed active warfare. Unless these newly-seen troops should be suffered to cross the water—and the prospect of such a movement seemed to be shut out by the order for transferring the army's heavy baggage from the South to the North Side—there would still be long difficult marches to divide them from the enemy.

In the course of the day, Prince Mentschikoff came down in person from the Upper Belbec to the Severnaya, but did not pass over the water. He rested in the Severnaya and there received the devoted Admiral who, since the two men last saw each other, had been forced by his love of country to usurp the command of Sebastopol.

Prince Mentschikoff gave assent to the kind of dictatorship which

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had been created in his absence ; for he treated it as quite natural that Korniloff had been raised to the supreme authority.

After complaining of the weakness of his army, and declaring his belief that the enemy was in great strength, he intimated that he was about to make another movement, and gave Korniloff to understand that he, the Prince, meant to leave Sebastopol to its own resources.

Korniloff remonstrated, and said : " If that takes place then farewell to Sebastopol ! If the Allies decide on some daring action, they will crush us." Prince Mentschikoff then said that he would summon a council of war.

From the first the Russian Army in the Crimea had been scantily provided with skilled officers in the higher grades ; and on the day of the Alma out of the number who were competent a large proportion was killed or disabled, and of the officers of rank who escaped some, at least, were in a great measure shorn of their due authority by the comments and the blame and recriminations which too often follow defeat. As a result for the time at least the army was much out of gear, and it seems probable that the weakness of his army in point of officers was so fully realized by the Prince afterwards that he thought it necessary to withhold his army for a time from the sight of the enemy's outposts.

(*To be continued*).

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TIMBER TRESTLES AND RAILWAY BRIDGES.

By CAPT. P. O. G. USBORNE, R.E.

This subject is treated entirely from an active service point of view, only such materials as would probably be available being considered.

Road bridges for troops and vehicles, although identical in general principles, will not be touched upon here; they are fully described in *M.E.*, Part III.

Governing Factors.—(1) Rapidity of construction. (2) Material available. (3) Uncertain quality of materials and workmanship.

A Trestle Bridge consists generally of vertical timber frames suitably spaced out across the gap to be bridged, and spanned on top by "road bearers," or "stringers." These carry the sleepers and permanent way.

PRACTICAL POINTS.

Sleepers should be arranged close together over the span in order to distribute the weight of engine wheels, say 12 in. to 24 in. apart, centre to centre, or in pairs close together (*Fig.* 6).

Further distribution is sometimes obtained by using two layers of sleepers with a rail in between them, as in *Fig.* 10.

Stringers and Road Bearers usually consist of timber baulks, rails, rolled steel beams, or trussed timber beams. Any number of stringers are allowable.

Timber Baulks.—Four are usually employed, two under each rail. Where possible the length should equal twice the spacing of trestles, and adjacent stringers should be arranged so as to have their joints on alternate trestles.

If a single stringer is used under each rail, use a bolster to get good bearing (*Fig.* 4) or, better, overlap the ends of the stringers and bolt them together (*Fig.* 11). As the stringers are crossed by sleepers, it does not matter if they are not immediately below the rails.

Stringers should be given a shallow check (1 in) over the top of a trestle, and should be spiked, drift bolted, or dogged to the cap. Sleepers are fastened to the baulks by spikes. Timber baulks are suitable for spans up to 15 ft. or 20 ft. Four 12-in. × 12-in. baulks, two under each rail are good for a 15-ft. span for all locomotives.

Rails.—Specially suitable as stringers for short spans, one or more together, laid side by side. Take care that rails are kept close together. This is done by spikes into the cap of trestle. Sleepers are held down by clip bolts (*Fig.* 5). Ends of rails should be embedded if possible on both sides of the gap, in order to make them fixed instead of supported, giving additional strength.

Five rails (steel, 56 lbs. per yard) under each rail are good for an 8-ft. culvert for all engines.

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Fig. 4

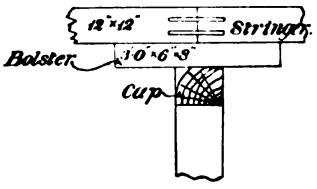


Fig. 5.

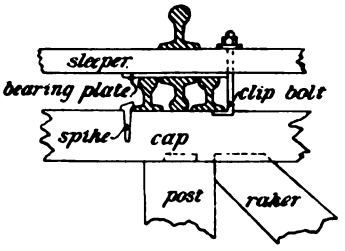


Fig. 6.

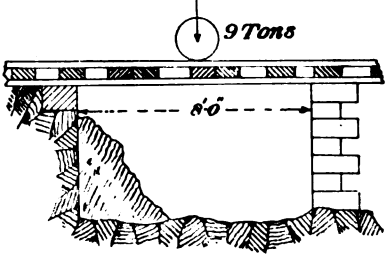


Fig. 7.

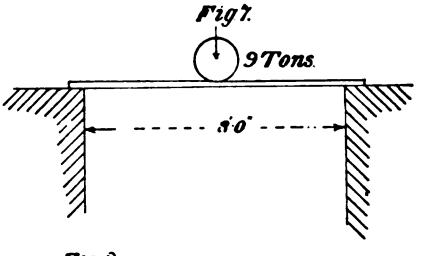


Fig. 8.

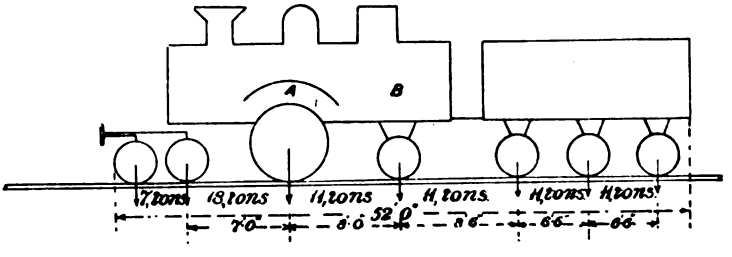


Fig. 9.

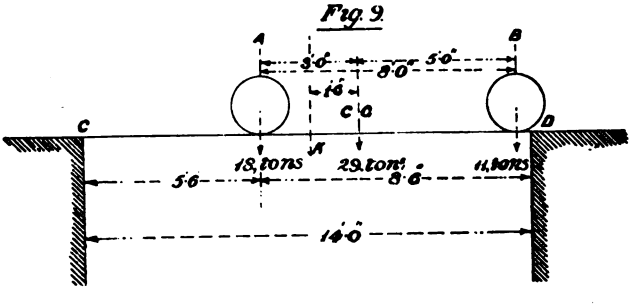
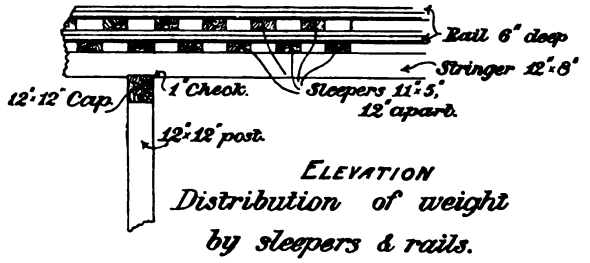


Fig. 10.



ELEVATION

Distribution of weight by sleepers & rails.

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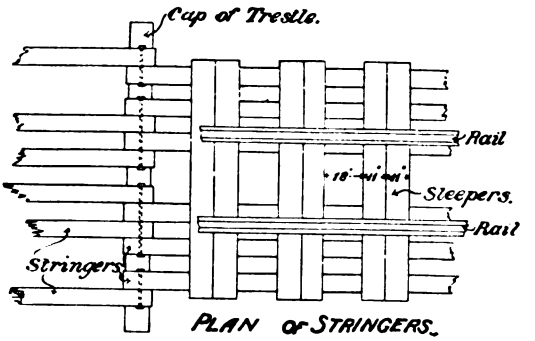
Fig. 11.



Meeting on a Trestle

CALCULATIONS FOR STRINGERS. THREE METHODS.

(i.). For small spans, 4 ft. to 10 ft., take the heaviest pair of engine wheels; assume them acting at centre of span, add a percentage for live load, shown in Table III., and work out as in Method I.

(ii.). For bigger spans, 10 ft. to 15 ft., where two or more pairs of wheels are on the span at one time, assume the two heaviest axles of engine to be on the span, add a percentage from Table III., and work out as in Method II.

NOTE.—When the distance between these two axles is greater than ·50 of the span, a greater M_f will be produced by the heavier axle at the centre of the span (as in case i.) than by the two axles in any position on the span together.

(iii.). For spans of 15 ft. and over, use the equivalent dead load given in Table IV. Add a percentage from Table III., and solve as a uniformly distributed load, as in Method III.

GENERAL FORMULÆ AND NOTATION.

The *Bending Moment* on stringers is :—

$M_f = \frac{Wl}{4}$ for a concentrated central load.

$M_f = \frac{Wl}{8}$ for a uniformly distributed load.

where W = total load on the span in lbs. or tons,

l = length of span in inches,

M_f = bending moment produced either in inch-lbs. or inch-tons, according to the unit of W.

The *Moment of Resistance* of a timber baulk is :—

$M_r = \frac{1}{6} rbd^2$ for rectangular section (timber),

$= \cdot 785\, r\, R^3$ for solid circular section (timber),

$= \frac{rI}{y}$ for all sections.

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Where r=safe resistance per square inch to tension or compression in lbs. or tons.

b=breadth of beam in inches.

d=depth of beam in inches.

R=radius of the section in inches.

I=moment of inertia of the section in inch units.

v=distance of neutral axis to the extreme fibre, or half the depth of the section in symmetrical sections.

M_r=moment of resistance in inch-pounds or inch-tons, according to the unit of r.

In equating $\mathbf{M}_r$ and $\mathbf{M}_f$, care should be taken that they are in the same units, either inch-pounds or inch-tons.

r, the safe intensity of stress per square inch, is usually taken as 1,200 lbs. in fir, 6½ tons in steel, and 5 tons in W.I. This is for permanent construction, and allows a factor of safety of 5 for timber, and 4 for steel and iron. For temporary work these values are low, and a factor of safety of 3 gives values of r :—

r=2,000 lbs. for fir.
r=9 tons for steel.
r=7 tons for W.I.

FACTORS OF SAFETY GENERALLY.

Stringers worked out by the formulæ and methods given in pp. 365 and 366 have much larger scantlings than those used in actual practice. The reason is that there are several factors of safety included in the formulæ :—

(i.). An addition is made from Table III. to compensate for live load, reducing it to equivalent dead load. For temporary work on service, the speed of trains over bridges can often be reduced; if this is possible, and the train crosses "dead slow," there is no necessity for this live load compensation whatever. If, however, it would interfere with expeditious running of trains to slow up, then the addition must be made.

(ii.). In railway work, the timber available will generally be well seasoned and sound (although the ends may be damaged). In this case, r may certainly be taken as 2,000 lbs. per square in. for fir, and all other timbers in proportion, based on a factor of safety of 3. If doubt exists, 1,500 lbs. may be taken, giving a factor of safety of 4.

If, however, the timber is new and unproved, a factor of 5 should be used.

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On service, it will usually fall out that only one scantling of timber baulks is available; in such a case the Engineer must satisfy himself by inspection as to what factor to allow. If the factor of safety be reduced to 2 the material approaches dangerously near to its elastic limit; this cannot be allowed.

(iii.). In many cases stringers are really fixed or partly fixed at one or both ends, as, for instance, a stringer that is continuous over two spans.

(iv.). The distribution of the weight of an engine wheel by the rail and sleepers tends to reduce the bending moment of the stringer, making the concentrated load approximate to a distributed load. This is too indeterminate to allow for in calculating, but should be borne in mind.

NOTE.—Instead of adding a percentage for live load from Table III., r may be reduced as follows:—

Baltic fir	.. .. ..	r=20% reduction.
Steel	.. .. ..	r=4½ tons up to 20-ft. span.
		5 ,, ,, 30-ft. ,,
		5½ ,, ,, 80-ft. ,,

Deduct 20% from above values for steel for W.I.

At the same time, the use of Table III. is recommended, the practice of reducing r being rather arbitrary and uncertain.

The equivalent distributed live loads shown on Table IV. do not include any F. of S.

The discrepancy between theory and practice over small spans is not so much as for large spans.

The weight of superstructure is negligible throughout.

Table I. gives scantlings of timber commonly used in practice over various spans.

Table II. gives the safe loads on steel rails under all ordinary locomotives, over different spans, as used in practice.

Method I.—To calculate number of rails for road-bearers over 8-ft. gap (*Fig.* 6). *56-lb. steel rails* (*details, p.* 206, "*M.P.B.*").

This is a small span, so treat W as central load.

Heaviest axle load of engine=18 tons=9 tons per single wheel (*Fig.* 8).

Adding percentage from Table III., equivalent dead load=9 tons +27%=11·5 tons nearly.

(*a*). Consider the rails as supported beams. Then let n=number of rails required under each wheel.

$$M_f = M_r \times n.$$

$$\therefore \frac{Wl}{4} = r\frac{I}{y} \times n.$$

$$\therefore \frac{11{\cdot}5 \times 8 \times 12}{4} = 6{\cdot}5 \times \frac{I}{y} \times n.$$

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To find I for the rail :—

Find the neutral axis by drawing out the section of the rail and dividing it up into rectangles.

Find their *c.g.* $Ay_0 = \Sigma A_1 y_1$ (y_0 = distance of *c.g.* from extreme fibre).

Then find I by Appendix XIV., *Rivington*, Pt. IV., or *S.D.I.*, p. 100.

In this case, with a 56-lb. steel rail,

$y_0 = 2{\cdot}1''$.

$I = 12{\cdot}3''$.

Therefore, substituting—

$$n = \frac{11{\cdot}5}{4} \times 8 \times 12 \times \frac{2{\cdot}1}{12{\cdot}3} \times \frac{1}{6{\cdot}5}$$

$$= 7{\cdot}25.$$

Hence 8 rails are required under each wheel, giving the safe load on each rail as $11{\cdot}5 \div 8$, or 1·44 tons.

Compare Table II., which gives the safe load as 2·65 tons distributed, or 1·32 tons concentrated, and note that the normal value has been taken for *r* in this example, viz. : 6·5 tons.

(*b*). A formula is given for W.I. rails in the *R.E. Field Service Pocket Book*, p. 14.

$$S = \frac{\cdot 02\,(wgt)^2}{L}$$ where $\begin{cases} S = \text{safe load in tons for W.I.} \\ L = \text{length in feet.} \\ wgt = \text{weight per yard of rail in lbs.} \end{cases}$

for central load.

Substituting—

$$S = \frac{\cdot 02\,(56)^2}{8} \times \frac{6{\cdot}5}{5}$$ (ratio of steel to W.I. = 6·5 : 5) = 1·36 tons.

Since therefore 9 tons is weight on one wheel,

$$\text{No. of rails required} = \frac{9}{1{\cdot}36} = 7 \text{ nearly under each rail.}$$

Compare previous result. No percentage for live load is added here, the formula containing its own live load correction.

NOTE.—This formula is not recommended for general use, containing, as it does, special symbols and having no particular advantage over the ordinary $M_f = M_r$. It is merely quoted here for sake of collateral comparison.

(*c*). If whole rails, 30 ft. long, were employed, with their ends well and thoroughly bedded under the track on both sides of the gap that is to be bridged (*Fig.* 7), and the sleepers arranged close together on top, so as to get good distribution of load, the rails might safely be considered as "*fixed*" or "*half-fixed.*"

Consider the rails as "*fixed.*"

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The M_f due to a central load on a fixed beam is $\frac{Wl}{8} = r\frac{I}{y}n$ as before.

Adding a percentage for live load and substituting—

$$\frac{11{\cdot}5 \times 8 \times 12}{8} = 6{\cdot}5 \times \frac{12{\cdot}3}{2{\cdot}1} \times n.$$

$$\therefore\ n = \frac{11{\cdot}5 \times 8 \times 12}{8} \times \frac{2{\cdot}1}{6{\cdot}5 \times 12{\cdot}3}$$

$$= 3{\cdot}62.$$

Therefore four rails are required, *i.e.*, half the number found above in (*a*).

(*d*). If work were hurried, and fixing appeared to the Engineer to be dubious, "*half-fixed*" might be allowed for, giving six rails as the necessary minimum under each wheel.

Method II.—Take a 14-ft. span, timber baulks, and 78-ton Midland engine; calculate baulks (*Figs.* 8 and 9).

Consider the two heaviest axles, 18 tons and 11 tons, called A and B in *Fig.* 9.

First find the *c.g.* of A and B. Let *c.g.* be x ft. from A.

Taking moments round A—

$$(18 + 11)\,x = 11 \times 8,$$

$$x = \tfrac{88}{29}$$

$$= 3' \text{ nearly.}$$

The rule for two rolling loads on a span, when kept at a fixed distance apart, is this :—

"*The maximum* M_f *occurs under the heavier load, at the moment when the centre line of the span bisects the distance between the heavier load and the c.g. of the two loads.*"

Draw the two heaviest axles in this position, as in *Fig.* 9, so that A (18 tons) is 1 ft. 6 in. from the centre of span. This is the position of maximum M_f.

To obtain R_c (reaction at C), take moments round D.

$$R_c \times 14 = 18 \times 8'\ 6'' + 11 \times 6''$$

$$= 18 \times \tfrac{17}{2} + 11 \times \tfrac{1}{2}.$$

$$\therefore\ R_c = 11{\cdot}32 \text{ tons.}$$

Now, the bending moment at A

$$= R_c \times 5'\ 6''$$

$$= 11{\cdot}32 \times 5\tfrac{1}{2}' \text{ tons.}$$

$$= 62{\cdot}26' \text{ tons.}$$

Adding 23% from Table III., $M_f = 76'$ tons.

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Substituting in the formula :—

$$M_f = \tfrac{1}{6} rbd^2.$$

$$76 \text{ (ft.-tons)} \times 12 \times 2{,}240 = \tfrac{1}{6}\ 2{,}000\ bd^2.$$

$$\therefore\ bd^2 = \frac{76 \times 12 \times 2.240 \times 6}{2{,}000}$$

$$= 6{,}120 \text{ nearly.}$$

This is for the whole track, axle load having been taken.
Assume four stringers, two under each rail.

$$\text{Then } bd^2 \text{ for each} = \frac{6{,}120}{4}$$

$$= 1{,}530$$

$$= 10 \times 12^2 \text{ nearly,}$$

$$\text{or} = 9 \times 14^2.$$

Hence two 12 in. × 12 in. under each rail will be ample, or two 9 in. × 14 in., or even one 14 in. × 14 in.

Compare this result with Table I., and note the large value taken for r above. If r had been taken as 1,500 lbs., two 10 in. × 14 in. baulks would have been required.

NOTE.—If the span in the preceding example had only been 13 ft., the distance between the heaviest axles would have exceeded ·59 of the span, and the greatest M_f would have been produced by placing the 18-ton axle at the centre.

Method III.—Calculate stringers for a 20-ft. span ; 78-ton engine.

From Table IV. the uniform equivalent load for this span is about 3 tons per foot-run.

$$\therefore \text{ total load} = 3 \times 20 \text{ tons}$$

$$= 60 \text{ tons.}$$

Formula then is :—

$$\frac{Wl}{8} = \tfrac{1}{6} rbd^2.$$

$$\therefore\ bd^2 = \frac{60 \times 20 \times 12}{8} \times 2{,}240 \times \frac{6}{2{,}000}$$

$$= 12{,}096.$$

This is for the whole track, axle loads having been taken.
Assuming two stringers under each rail,

$$bd^2 \text{ for each} = 3{,}024$$

$$\text{if } b = 9''.$$

$$d^2 = 336.$$

$$\therefore\ d = 18'' \text{ nearly.}$$

Therefore two 9 in. × 18 in. under each wheel will do.
Compare Table I., and note value of r taken.

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Summary of Calculations.

"*Temporary*" and "*Semi-permanent*" work must be distinguished. The former implies work executed hastily, and not intended for use for more than a few weeks at the most; the latter implies some considerable duration, up to six months or a year, or even the whole of a campaign.

Temporary work, therefore, admits of the use of large constants, such as 2,000 lbs. for a value of r in timber, small factors of safety, and possible omission of all percentage for live load, if trains can be sent over the bridge "dead slow."

Semi-permanent work on the other hand calls for more care and a larger factor of safety, and the percentage for live load should always be added.

In both cases the permanent way must be most carefully laid and maintained, and the sleepers must be close together, each supplying a firm bearing to the rail above.

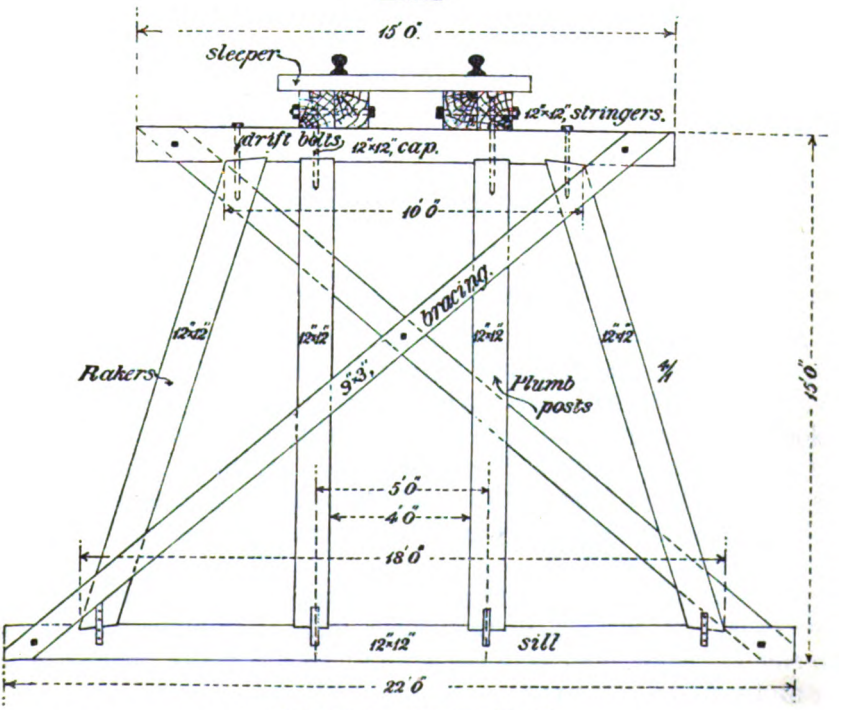
Trestles.

Trestles are treated under the following heads:—

Framed trestles, pile trestles, high framed trestles, trestle piers, crib piers, other piers.

Framed Trestles (*Fig.* 1).—A framed trestle generally consists of

Fig.1.



SIMPLE TRESTLE.

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two upright posts placed underneath the rails, called "*plumb posts*," and two outer sloping posts called "*rakers*."

These rest on a "*sill*" at their lower ends, to distribute their weight on the foundations, and they are covered by a "cap" at the upper ends, to carry the stringers. The posts, sill and cap are fastened together either by "*fish-plates and bolts*" or by "*dogs*," or by "*drift bolts*." Drift bolts are long iron spikes with a point one end and a head at the other.

Trestles are sometimes braced together by *sway bracing*, as shown in *Fig.* 1; and in order to keep them in a vertical position, *longitudinal bracing* is sometimes required from the top of one trestle to the bottom of the next, along the direction of the bridge.

Framed trestles are used in one panel up to 20 ft. high, or sometimes 30 ft.

Over 20 ft. high usually make in two panels. Convenient spacing 15 ft. Posts 12 in.×12 in., or 10 in.×12 in., cap 12 in.×12 in. Sway bracing 9 in.×3 in., or 12 in.×3 in., bolted. Cap, drift, bolted, or dogged, spiked, etc., bottom sill 12 in.×12 in., notched for posts usually.

Plumb posts should be under rails; head of rakers 1 ft. to 1½ ft. clear to either side, feet 3 ft. 6 in. to 4 ft. 6 in. clear to either side.

Up to 6 ft. high four vertical posts are good; above 6 ft. use rakers.

Level up after fixing the stringers, by wedges under trestles. Base should be anchored against rush of water, etc.

To test the posts for stiffness (not usually necessary), assume 16-ft. span, 2½ tons per F.R. Then total weight=40 tons: if bd=section of a post, $4bd$=total cross section of posts of trestle.

$$\therefore\ 4bdr_c = 40 \text{ tons.}$$

$$\therefore\ bd = \frac{40 \times 2{,}240}{1{,}000 \times 4} = 22{\cdot}4.$$

$$\therefore\ b=4,\ d=6.$$

$\therefore$ 10″×12″ posts are ample.

Pile Trestles.—Not in frequent use; too slow for hasty work; useful on soft foundations. Four piles driven into ground; all vertical up to 10 ft. high—above 10 ft. outside two driven raking (slope $\frac{1}{4}$); usually 12 in.×12 in.; cut off to level and capped with 12 in.×12 in.; drift bolted; sometimes morticed and tenoned, usually notched. The posts should be spaced as in framed trestles.

Sway bracing required (3 in.×9 in. or 3 in.×12 in.) when trestle is more than 10 ft. high.

High Trestles.—Make in two panels; upper panel of even length, say 15 ft. high throughout the bridge, odd length in bottom panel, to suit the conformation of the bottom. Members of upper trestle in prolongation of lower.

Horizontal bracing is carried all along at each tier. Diagonal

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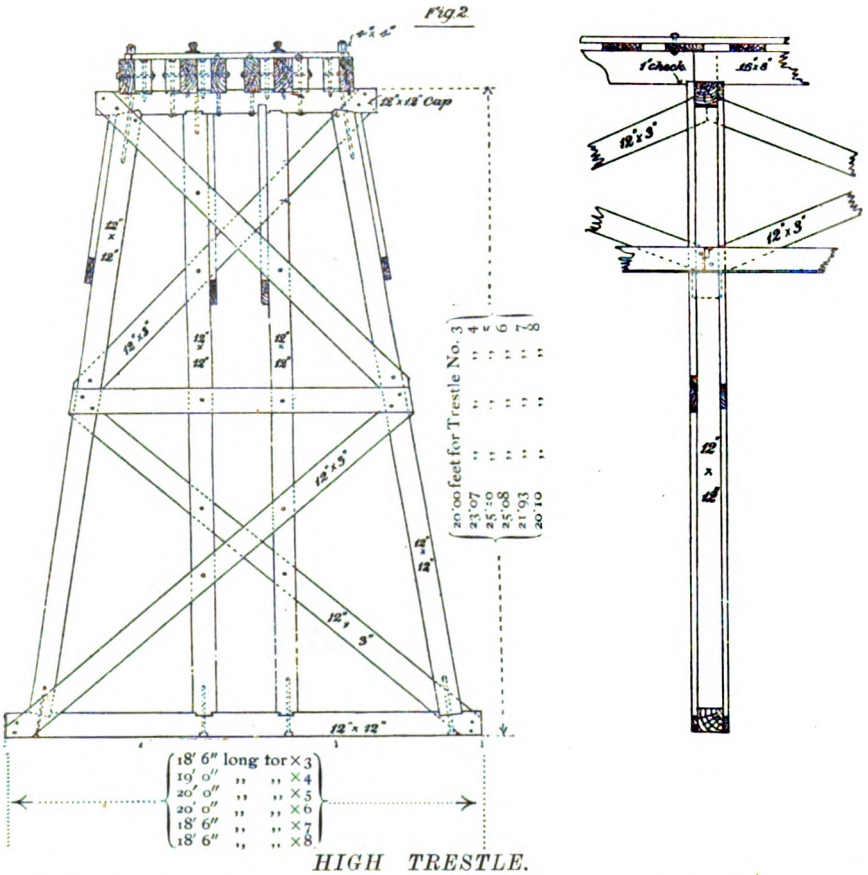
longitudinal bracing may be provided to every bay; or every third bay may be braced into a tower, if necessary, to keep lots of waterway clear in adjoining bays.



HIGH TRESTLE.

Trestle Piers.—Where very high trestles in use, put in pairs close together; to form piers or towers, cross-brace firmly all the way up.

For span 40 ft. place them 5 ft. apart.
For span 20 ft. place them 4 ft. apart.
For span 10 ft. place them 3 ft. 6 in. apart.

Trestle piers should always be used when the span between high trestles exceeds 25 ft.

Crib Piers consist of sleepers piled cross-wise on top of each other. They are very wasteful of sleepers; quickly erected; require no skilled labour; large working parties can work on them—but they block up waterway—must be filled and surrounded with stones or concrete when required to resist flow of water. They are notched together, or merely spiked. For erection in water, construct bottom part on shore; floor in bottom; float off and then sink by filling with stones.

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Up to 8 ft. high use single crib piers.

From 8 ft. to 18 ft. use double crib piers, transversely to the permanent way.

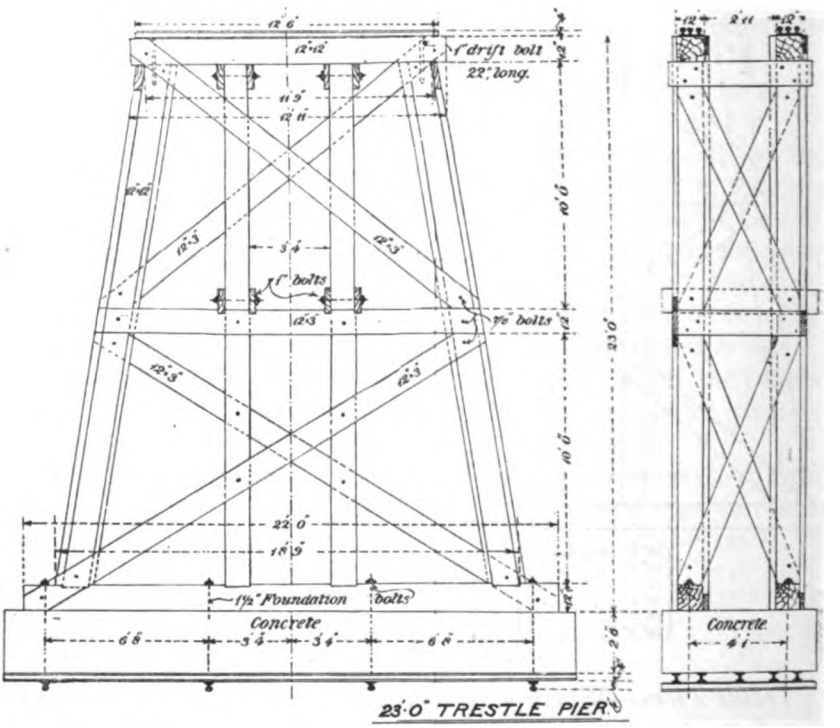
Over 18 ft. use treble crib piers.

These must be tied through longwise with rails at intervals.

Above 18 ft. high speed of erection and economy decrease very rapidly.

Maximum economical height=25 ft.

Fig 3



25'0" TRESTLE PIER

Sandbag, Stone, Concrete Piers, etc.—Stones or sandbags can be used as revetments to low earth piers, when clear of water. Stones or sandbags can be used alone, as temporary expedient. When using earth pier with sandbag revetment, top of pier should be—

12 ft. × 6 ft. for 40-ft. span
12 ft. × 5 ft. for 20-ft. span
12 ft. × 4 ft. 6 in. for 10-ft. span
} Batter of sides $\frac{6}{1}$.

On the top rests a solid wooden frame of 6-in. stuff to take superstructure or bearers.

A similar frame should be introduced into the pier every 5 ft. of height for bond.

Concrete is not much used in hasty work, but very much used for footings in semi-permanent work or low piers.

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Joints.—All bolts ¾-in. diameter, with washer at head and nut.

¾-in. to 1¼-in. bolts take 3-in. to 4½-in. diameter washers ¾ in. thick.

Drift bolts are ¾-in. square or round iron.

Smooth rods are better than jagged in timber.

Round have 25% more holding power than square.

1-in. round bolt in ¾-in. hole in Norway pine has 9,000 lbs. pull per F.R.

All bolt holes ⅛ in. smaller than bolt.

Screw bolts 50% more hold than smooth.

Spikes.—Straight, with chisel point are best (*M.P.B.*, p. 202).

Holding pull=300 lbs. per square inch of surface of spike in fir. Holes half diameter of spike.

Dogs.—¾-in. iron. Their points should be sharpened by bevelling on the inside only, so as to draw together the parts that are being joined.

Foundations.

Rock.—Rest the sill of the trestle on a bed of rock cut level, or made up level with concrete. If below water, make up level with concrete in bags.

Ordinary Soil.—The sill is laid on a platform of sleepers cut in half, placed transversely to the sill. It must depend on the soil whether this platform need be continuous or is only required under the posts.

The sill must be anchored if below flood level or below water.

Sand.—Use a low crib pier resting on a floor of sleepers, or cover a large area with crossed sleepers several layers deep, if the sand is very soft, and found on this.

Bog, Sludge, Mud.—Use long spans between trestles. Under the trestles use piles, or cut a trench through the soft stuff on to the hard, and fill with solid filling, *e.g.*, concrete.

For piles a convenient arrangement is two rows of piles 5 ft. apart, and 5 ft. spacing.

Scouring.—In permanent work, the masonry of the bridge is joined up under water to form an apron, in small spans.

In temporary work, spans up to 10 ft., floor in the underneath with timber flooring and drop walls. Bigger spans, pile ground over with boulders 1 ft. deep or so, with a big pile round each trestle foot. Carry foundations well down; ordinary soil, masonry abutment :—

10-ft. span, 3 ft. deep
20-ft. span, 4 ft. deep } To prevent scouring.
40-ft. span, 6 ft. deep

Trestle piers should be protected by piled stones, or if current liable to become very strong, by crib piers filled with stones; or sheet piling, triangular in plan, like a dolphin. Concrete flooring is sometimes put in under the spans.

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TABLE I.

TABLE OF SCANTLINGS FOR STRINGERS.

(The numbers given are for both rails, *i.e.*, half under each rail).

DEPTH OF BEAM IN INCHES.

Span. $d=$	20″		18″		17″		16″		15″		14″		13″		12″		11″		10″		9″		8″	
	No.	*b*	No.	*b*	No.	*b*	No.	*b*	No.	*b*	No.	*b*	No.	*b*	No.	*b*	No.	*b*	No.	*b*	No.	*b*	No.	*b*
25′	..	..	6	9″	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
22′	..	..	2	18″	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
20′	2	20″	4	9″	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
18′	..	..	4	9″	..	..	6	8″	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
16′	..	..	..	..	3	8″	4	8″	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
15′	..	..	2	9″	2	10″	4	8″	..	..	2	14″	..	..	4	12″	..	..	..	..	..	..	..	..
12½′	..	..	..	..	..	..	2	8″	..	..	4	6″	..	..	3	12″	..	..	..	..	..	..	..	..
10′	..	..	..	..	..	..	..	..	2	8″	..	..	..	..	3	12″		..	..	..	..	..	..	..
8′	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	12″	..	..	..	..	..	..	..	..
6′	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	12″	..	..	..	..	..	..	..	..

Equivalent of any of these easily found by multiplying up $b\,d^2$, and then altering value of b or d as required, or adding or deducting percentage for increased weight of engines, etc., etc.

These data are compiled from Railway Report, S.A. War and other engineering books, and are the result of practical experience, for ordinary semi-permanent work—for 68-ton engines or over, up to 100 tons.

They may be taken as good enough for hasty work in the field.

Timber baulks—good Baltic fir, where $r_c = 1{,}500$ safe.

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TABLE 11.

TABLE OF SAFE LOADS ON SINGLE RAILS IN TONS.

(NOTE.—Flanged steel rails of standard sections, *M.P.B.*, p. 206).

WEIGHT IN LBS. PER YARD RUN OF RAIL.

Span.	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
12′	·713	·90	1·09	1·31	1·53	1·77	2·02	2·27	2·51	2·75	2·98	3·21	3·44	3·69	3·91
10′	·856	1·07	1·32	1·57	1·84	2·12	2·42	2·73	3·01	3·29	3·57	3·85	4·13	4·43	4·69
8′	1·07	1·35	1·65	1·96	2·30	2·65	3·02	3·41	3·77	4·12	4·47	4·82	5·16	5·53	5·87
7′	1·22	1·54	1·89	2·24	2·63	3·03	3·46	3·90	4·31	4·70	5·10	5·51	5·9	6·33	6·70
6′	1·43	1·80	2·2	2·62	3·07	3·54	4·04	4·55	5·02	5·49	5·87	6·42	6·88	7·38	7·83
5′	1·71	2·16	2·63	3·14	3·68	4·25	4·84	5·46	6·03	6·73	7·14	7·71	8·28	8·86	9·39

The above are in tons for 1 rail, distributed load.

For central load divide by 2.
30% is allowed for live load ; r_c for steel=6·5 tons.
For small spans, over culverts, etc., up to 12 ft., load must be considered central.
Spans 12 ft. and up can be treated as distributed, equivalent distributed load being used from Table IV.

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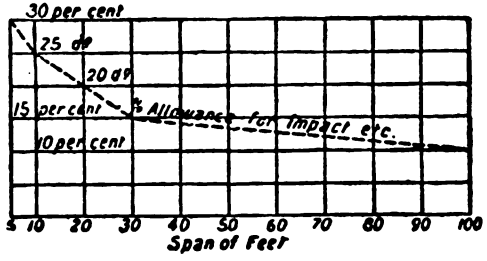
TABLE III.



From *The Engineer*, May 8th, 1903.

TABLE IV.

TABLE OF EQUIVALENT DISTRIBUTED LIVE LOADS FOR HEAVIEST LOCOMOTIVES IN GREAT BRITAIN ON SINGLE-LINE TRACK.

Span in feet	10′	15′	20′	25′	30′	35′	40′	45′	50′	60′	70′	80′
Tons per foot-run	3·99	3·72	3·44	3·35	3·28	3·06	2·88	2·67	2·50	2·27	2·27	2·26
Span in feet	90′	100′	120′	140′	160′	180′	200′					
Tons per foot-run	2·25	2·24	2·23	2·22	2·21	2·20	2·18					

From Paper by Mr. J. C. Inglis, M.I.C.E., in *Proceedings of Institute of Civil Engineers*, Vol. CLIV., p. 22.

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TRANSCRIPT.

HISTORY OF UNDERGROUND WARFARE.

Being a Review of the book by A. GENEZ, Captain of Engineers, French Army.—(Librarie Militaire Berger Levrault, Paris, Rue Des Beaux-Arts 5–7, 1914. Price 5 francs).

(*Concluded*).

SIEGE OF TU-YEN-KWAN, *23rd November*, 1884, *to 3rd March*, 1885.

During the Tonkinese War 600 men held Tu-yen-kwan against a Chinese army. The latter fired 10,000 shells and 1,000,000 cartridges, opened 5 miles of trenches, excavated 10 galleries, and fired 7 mines. Improvements to the defences and countermine works were all directed by Serjt. Bobillot, of the Engineers, to whose zeal, intelligence and initiative the success of the defence was in a great measure due. The defenders had no powder for mines, all they could do was to try to penetrate the enemy's galleries, and if not successful in doing so, at any rate their countermine galleries might constitute a species of safety valves, and dissipate harmlessly to some extent the effect of the enemy's explosions. The little garrison held out long enough to enable a column to arrive to relieve them.

SIEGE OF PORT ARTHUR, *May*, 1904—*January*, 1905.

Omitting all general description of the country, fortifications, and strengths of the rival armies, the progress of the underground warfare only will be followed. The most important works were those undertaken against three of the detached forts, North Ki-kwan, East Erh-lung and Song-shu-shan. The Russians were driven within their main line of defence on the 28th of July, 1904. Between the 19th and 25th of August the Japanese Army, under General Nogi attempted an *attaque brusquée*, and gained a little ground, but it was evident that regular siege works would have to be undertaken.

North Ki-kwan Fort is pentagonal in shape, its front facing north-east. The parapets of the face and flanks were 10½ ft. above the terreplein and 24½ ft. thick. The ditches were not revetted, and were about 13½ ft. deep and 25 ft. wide. The flank ditches were enfiladed from casemates built opposite the front face in the counterscarp, which was indented for that purpose. The walls and roofs of these casemates were of concrete 3 ft. thick. Communication with the interior of the fort was by a counterscarp gallery sloping downwards along the right flank as far as the gorge, and then by a passage under the ditch. At the time of the siege these galleries were incomplete. Double-storeyed barracks with ditches closed the gorge faces, and the gorge ditch to the left was

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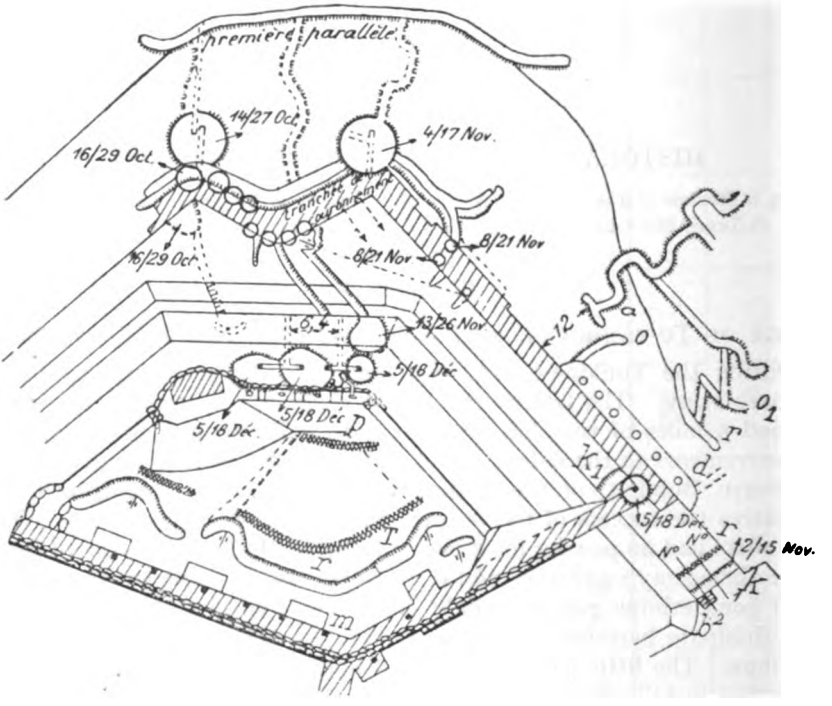
flanked by a caponier. Sandbag parapets were erected on the barrack roof. There was a bridge over the gorge ditch which was under fire from the Japanese position.



Works of Attack and Defence of Fort No. II.

At each flank of the casemates in the salient two arches had been left, from which countermine galleries were to have been driven, but these had not been commenced. By the middle of September the Japanese saps were not far from the fort, and it appeared that further progress was being made by mining. On the 14th countermining was begun by parties of 16 men with 8-hour reliefs, the Sappers were untrained in mining, most of the picks and shovels had been lost in the advanced positions (Nan-shan, etc.) and those bought locally were of very inferior quality. Later on a few tools of extreme lightness and strength were captured from the Japanese, indeed they were the object of several sorties. In the left-hand gallery work proceeded rapidly, in the right-hand gallery rock had to be removed with hammer and chisel.

As nothing definite was known of the Japanese mines, a sortie was organized on the 15th of October. The troops were armed with rifles, hand grenades and torpedos of guncotton in tin cylinders, the last intended for blowing up the Japanese mine shafts. The sortie failed, and a similar attempt next day met with as little success, countermining proceeded therefore very much by guess work. On the 16th the left gallery was about 17 ft. long when the crater of a Japanese shell was broken into. As no plans of the fort were available, the gallery had been driven too close to

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the surface of the glacis. The opening was closed and a shaft sunk a yard further back to 13-ft. depth, whence the gallery was continued towards the front. Part of the shaft was cased in, the remainder was not revetted. On the 17th accessory defences were prepared by fixing fraises on the berms, wire entanglements in the ditches, and fougasses, and planks studded with nails on the glacis. Every fougasse to be fired electrically was abortive, the conductors had been laid on the ground, and were all sooner or later cut by shells.

On the 20th of October a fairly successful sortie took place, and it was ascertained that the Japanese had two galleries, one directed towards the centre of the front face, and another towards the left salient. This was, as a matter of fact, wrong, there was only one gallery; it would appear that the reports of soldiers were relied upon, and that no officer had been specially detailed to verify the information. On the 23rd from the left gallery the Japanese miners were heard, on the 24th the Japanese stopped work when the Russians did so, and *vice versâ*. It was evident that each knew of the other's presence. On 25th two more shafts were sunk in the floor of the casemates, whence fresh galleries could be driven if required. On the 26th it was estimated that the Japanese were only 5 ft. away to the left of, and slightly above the Russians. Lieut.-Colonel Rachevski, of the Engineers, calculated at 210 lbs. the charge for what was intended to be a camouflet, with L.L.R. of 21 ft., and coefficient for loamy soil, but Colonel Grigorenko, the Chief Engineer, using the higher coefficient for rock, decided to use 285 lbs. There was no powder nor means of ignition in the fort, and an officer of the *fougassiers* was sent for to bring the necessary materials. At 8 p.m. the Governor, Lieut.-General Smirnov, arrived, gave orders to charge the mine, and expressed a wish to fire it himself. Five detonators were placed in the charge, the conductors were 5-stranded and lead sheathed, and were taken from the mine in two groups in case of accident. A man watched a galvanometer during the charging and tamping to make sure of the electrical continuity of the circuit. A man was placed in the gallery to work with a pick, and deceive the Japanese as to what was really going on. Air spaces seem to have been left in the tamping. The mine was fired at mid-day on the 27th of October, and two officers standing in the casemates close to the entrance to the gallery heard no noise at all. Mr. David James, an English correspondent with the Japanese, relates that a squad of six of the Engineers of the guard worked till the last endeavouring to reach the Russian mine and remove the powder. Three were afterwards taken out badly wounded, the other three must have been killed. The explosion destroyed a large portion of the Japanese gallery, at the same time the ground was so disintegrated that the latter were able next day quickly to drive a sap up to the concrete wall of the casemates. Another report states that a corner of the building was actually exposed at the rear edge of the crater.

On the 28th the Japanese blew a large hole in the corner of the casemate, the explosion extinguishing the lights in the rooms. Miners' candles were distributed and lighted, rifles posted to prevent the Japanese entry, and attempts were made to block the hole with sandbags. A sandbag parapet was erected in the next room opposite the communicating arch-

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way. The Japanese now blew up the sandbags in the hole they had made, and leaping in, drove the Russians behind their parapet, and placed a machine gun opposite it. Hand grenades were thrown, and the air became so vitiated that the candles were again extinguished. A Russian grenade set fire to some explosives brought by the Japanese, partially wrecking the casemates, and driving the Russians back to the further rooms. Colonel Rachewski now arrived, order was restored, and the Japanese driven out. After some time an officer of the Russian Engineers and a soldier managed to slide into the ditch, and blew in a loophole of the casemate on the left of the Japanese sap, entered the room, and secured themselves with sandbags. Grenades thrown through the hole, and a hot fire from the ramparts, checked all further approaches of the Japanese, on the other hand neither could the Russians break out.

The Russians now placed explosives in the walls separating the rooms of the casemates in their rear, for use in case they were driven back. They were arranged to be fired electrically from the counterscarp gallery. Meanwhile their right gallery had advanced about 35 ft., and a charge of 575 lbs. powder was placed in it. On the night of the 30th of October the Japanese breached the roofs of the remaining three rooms of the left half of the block of casemates, and drove the Russians into the right half. The Russians were thus no longer able to enfilade the ditch of the left flank of the fort. A party of Japanese tried to escalade the escarp, but were driven back.

On the 31st Japanese assaulted the right half of the casemates; the countermine prepared in the right gallery was fired and they retired. At 7 and 9 p.m. general assaults were made and repulsed.

On the 2nd of November the Japanese drove a sap round the back of their half of the casemates, and, entering the ditch by holes made in the front wall, managed to secure themselves on the exterior slope of the front face. In order to make sure of hitting them in this position the Russians had to tie grenades to cords, or their missiles rolled harmlessly into the ditch. The Japanese made wire screens to catch them, and could not be dislodged, indeed they had commenced a mine gallery in the exterior slope. The Russians placed a *cheval de frise* in front of the site of the expected explosion.

By the 9th of November the Russians had been driven out of three of the five rooms in the right half of the casemates, and the Japanese had pushed a mine gallery along the outside towards the right. On the 10th the Russians fired a second countermine from their right gallery. The tamping was insufficient, and smoke and flames were forced back into the casemate, but the Japanese gallery seems to have been damaged. On the 14th a third countermine was fired, of guncotton this time, as there was so little space for tamping. Some Japanese must have been cut off in their trenches by this explosion; they presently sent five carrier pigeons out to convey news of their predicament.

The Japanese were still heard at work outside the casemates, and on the 17th a fourth mine was fired from the right-hand gallery. It was at first intended to fire 70 lbs. guncotton, but this charge was doubled in the hope of securing a greater effect. The result was disastrous for the Russians. The back wall of the casemates was shattered, and the

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opening into the countermine gallery was exposed. The Japanese then attacked, but were driven off. A traverse was built opposite the opening, and a sort of fougasse was prepared and fired, but its only effect was to knock down the traverse. The latter could not be restored, and the Russians withdrew from the last casemate into the counterscarp gallery. The fight for the casemate had lasted six weeks, and for the next month a desperate struggle underground was to follow for possession of the gallery.

On the 19th of November the Japanese placed a 3-in. gun in the casemates, and destroyed the gorge caponier, but this gun was shortly put out of action by fire from the Little Eagle's Nest Battery. Three other guns consecutively met with the same fate. The Japanese then tried pumping an irrespirable gas into the counterscarp gallery, but this was remedied by making another opening, and operating a diver's pump to increase the ventilation.

On the 21st of November the Japanese boldly entered the ditch and blew in the wall of the counterscarp gallery behind the Russians, and fired through the opening with a 2-in. gun which they had brought into action in the ditch, behind the parapet of the covered way they had built leading to their gallery under the escarp of the front face. The Russians retired behind the next breastwork which they had erected, and a third breastwork was constructed further in rear. The Japanese also sapped along the back of the gallery wall, and blew another hole opposite that made from the ditch. The arched roof was blown in, and more asphyxiating gas pumped in, probably obtained by burning guncotton or melinite. The hole in the roof could not be closed for fear of suffocation.

The Japanese now made a traversed approach from the Kouropatkin Redoubt, which they had captured in September, towards the middle of the gallery, where the wall had not yet been covered with earth. They were within 50 ft. when the Russians began a counter-approach from the back of the wall. Fortunately a Russian sortie from the Kouropatkin Lunette succeeded in partly destroying the Japanese trenches.

Work on the gallery under the parapet had been pushed on actively, and on the afternoon of the 26th of November, after a tremendous cannonade from the siege batteries, the Japanese exploded two mines on the front face near the right salient, and assaulted the fort. A hand-to-hand fight ensued, and the Japanese were ultimately repulsed. At 1 p.m. Colonel Aoki himself rushed on to the parapet with the flag of his regiment, but the attack he led was also repulsed with great loss. The Japanese, however, held on to the mine craters and were only driven from them after nightfall. This was part of a general assault on all the works, in which the Japanese lost 12,000 men.

A calm followed, and the opportunity was seized by the Russians to construct a retrenchment in the fort, opposite the expected breach, and place in it two guns and two machine guns. The Japanese also recommenced their work on the exterior slope in spite of the grenades thrown by the garrison. They also repaired their sap opposite the right flank. While collecting their wounded the Russians took note of two Japanese mine galleries under the parapet on a level with the berm near

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the right salient, and another near the left. The retrenchment was strengthened with wire entanglement.

On the 4th of December the Russians unsuccessfully attempted to demolish, during a sortie, the Japanese approach on the right flank. They placed automatic fougasses in the hollow behind the wall of the counterscarp gallery, which besides causing loss to the enemy, would serve to warn the Little Eagle's Nest Battery that the fort was being attacked. Shots were still being exchanged daily in the counterscarp gallery.

On the 9th of December the Russians began to drive a gallery from the counterscarp gallery towards the Japanese saps on that flank. By the 13th the hourly expectation of explosions under the front parapet had reduced the garrison to an indescribable state of nervous tension. To counteract this two Boules' shafts were sunk in the terreplein for countermines, and a listening gallery in the parapet was loaded as a mine. On the 15th the Japanese threw some lighted arsenical compound into the counterscarp gallery to smoke out the Russians. Some hours later General Kondratenko and Colonel Rachevski were killed in the fort by the bursting of a 28-c.m. shell. In the death of the latter the defence experienced a severe loss.

Up to the 17th of December there was great indecision about charging the Boules' shafts in the fort. Capt. Schwartz, of the Engineers, wished to charge them, his arguments being firstly, that a Russian explosion would cause no panic in the fort, and would forestall the enemy, and secondly, that if the latter overheard the Russians tamping they would promptly fire their mines, but the garrison would be prepared for such an event, and would not be caught unprepared. General Foch would give no decided answer, so von Schwartz referred to General Gorbatovski who consulted the Chief Engineer. A council was convened and it was decided to charge the shafts on the 18th. This was too late.

On the 18th at 10 a.m. the Japanese opened a heavy fire on the fort. At about 1.30 p.m. three successive explosions took place in the front face of the fort, and the intensity of the fire was increased. As soon as order was restored guns and machine guns were cleared of the earth which covered them. A Japanese assault after the first explosion had been repulsed, a second assault after the second explosion was overwhelmed by the third explosion, which appears to have been premature. At 3 p.m. Colonel Aoki's regiment held the forward edge of the craters. Only 20 Russians in the fort remained fit for duty, and a counter-attack delivered by them failed. Reinforcements arrived, but their efforts were in vain, the Japanese erected a breastwork of sandbags on the edge of the craters, and placed machine guns behind it. By evening all the guns in the fort had been dismounted, and at 11 p.m. the garrison evacuated the fort, bearing with them wounded, ammunition, breech blocks, machine guns and provisions. The guns had to be abandoned, as the gorge bridge had been broken down. When the tail of the column was 100 yards from the fort the barracks were blown up with the explosives already placed in readiness in the walls.

Numerous comments have already been made on the folly of building counterscarp galleries exposed to a mine attack without adequate countermine protection. From the point of view of fortification it is interesting

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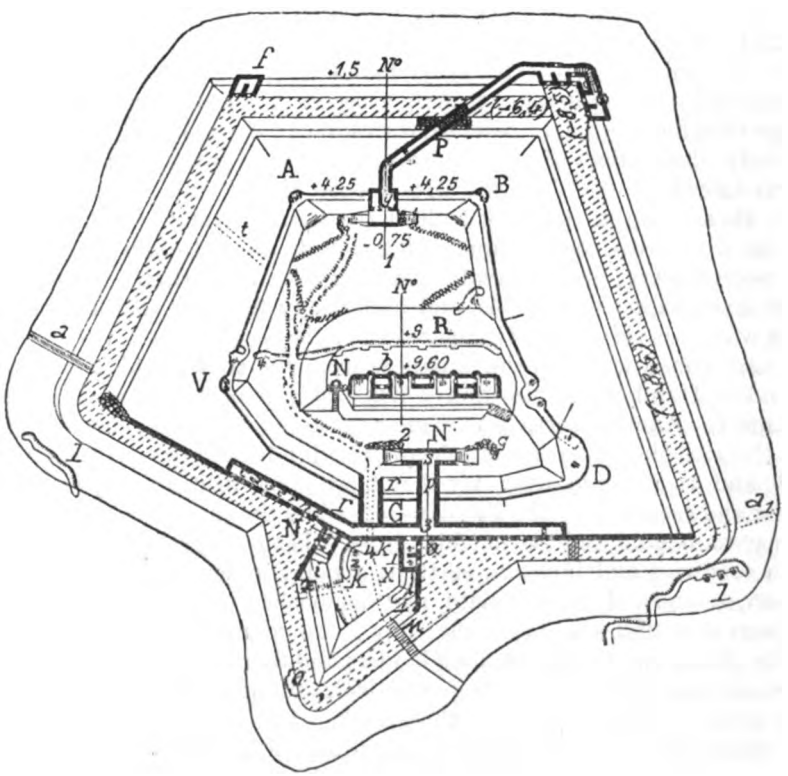
to note the efficient flanking defence afforded to the right flank of North Ki-kwan by the Little Eagle's Nest Battery. Doubtless the Great Eagle's Nest had as efficiently enfiladed the left flank, certainly the Japanese made no advance against that flank although they were in possession of the left end of the salient casemate at the end of October.

As regards the mine defence it seems evident that the Russians were unskilled in this nature of work. It was commenced too late, and the anxiety displayed over the arrangements for the first mine shows that it was considered no ordinary matter. Russian tenacity prevented the Japanese from immediately profiting by their capture of the left end of the casemates, but it is surprising that no attempt was made to countermine the Japanese advance under the front parapet. It cannot be argued that the enemy's fire prevented any work in the fort, since the Russians were able to build a retrenchment, and place obstacles there. In this particular instance borings would have been of immense service, but the Russians had no apparatus.

East Erh-lung Fort was situated on a spur of the Dragon Range. It and Fort Song-shu-shan mutually supported each other. The work consisted of a front and two flank faces with a curved gorge. At the outbreak of the war the ditches, cut in the rock, the concrete



Plan of Fort No. III.—Scale 1 : 2000.

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casemates at the forward angles of the counterscarp, and the concrete barracks closing the gorge, were just completed; the parapets had not been built and work was at once put in hand. Those of the front and flanks consisted of the natural rock with 2 to 3 ft. of earth over it. The gorge parapet was on the roof of the barracks, revetted with cement barrels and sandbags. Sandbag loopholes were made on all faces, the front face was also traversed. The left flank was exposed to view and reverse fire from Ta-ku-shan, and in August the banquette was widened, and a parados provided. The right flank was enfiladed from Wolf's Hill, and was given traverses and overhead cover of wooden beams covered with earth.

The terreplein was bare rock, and was covered with 1 ft. of earth. In the centre was a battery for four 6-in. guns, and an observatory tower. Officers' quarters, kitchens, magazines and latrines were all improvised. The front ditch was 21 ft. deep, and 28 ft. wide, the flank ditches sloped up to the gorge, the scarps were all vertical. In the right salient of the counterscarp was an L-shaped block of casemates for enfilade fire along the front and right flank ditches, a smaller casemate in the left salient flanked the left flank ditch. The former was reached by a passage under the ditch leading from the centre of the front face, the inner end of this passage was defended by a guard room. No gallery had yet been built to the casemate in the left salient, this casemate was therefore only approachable from the ditch and was consequently isolated. At the foot of the glacis was a wire entanglement.

It was only when the Russians found their counterscarp casemates threatened by the Japanese that they began to countermine. They first dug a trench in the glacis to defend the right casemate, and placed under it in shafts three mines of 70 lbs. of powder each. On the 26th of October when forced to abandon this trench they blew it up. Two openings were then made in the back wall of the right casemate whence it was intended to drive countermine galleries 30 ft. long, to join them by an envelope gallery, and excavate mine galleries from that. There were only seven sappers available, and hardly any tools for rock cutting, so that work was very slow. On the 28th a sortie was made to try to damage the saps constructed by the Japanese from the trench which had been abandoned and blown up, and which the Japanese had repaired and occupied. Another sortie was made next night, both were unsuccessful. On the 29th the Japanese were heard working behind the right casemate wall, and at 4.30 a.m. next day they blew a hole in it about 7 ft. in diameter and rushed in. The Russians retired by the passage leaving behind two 37-m.m. guns and two machine guns. The passage was then blocked with sandbags and boxes of earth at a point under the parapet. The Japanese wrecked the casemate, and demolished part of the front wall. A general assault was made that day; the columns reached the crest of the glacis, and brought scaling ladders and light footbridges, but these were all too short for the deep and wide ditches. Fire from the fort and adjacent works dispersed the attack. The left casemate had been cut off all day, and that night its garrison fell back into the fort. No countermining had taken place on that side. Although the Japanese advance had been by sap only, yet in a week's time they had won to

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the counterscarp; it had been very different at North Ki-kwan where the countermines, although commenced very late, delayed the attackers for three weeks.

The Russians now built two walls of stone in cement to block the passage under the front face; the first, close behind the barricade they had made, was solid except for a listening hole, the second, some yards further back had an opening at the top to throw grenades through, a shuttered loophole, and a manhole at the bottom.

By the 10th of November the Japanese had completed the works with which they crowned the glacis. On that day they blew up the casemate of the left salient, and made preparations to drive a mine gallery under the front ditch. They also attempted to bridge the ditch from the right casemate till a hot fire caused them to cease. On the 17th further attempts were made to demolish the right casemate, but the front wall was only cracked.

On the 18th more sappers were sent to the fort, and placed three charges each of 55 lbs. of melinite under the foundations of the passage guard room, so that it could be blown up if captured. Under the parapet of the left flank, and on the banquette, fougasses, each of 50 lbs. guncotton, were prepared, the electric conductors were buried 18 in. and the ends taken to the barrack. On the 19th, two countermine galleries were commenced, one from the right wall of the passage, between the two stone walls, the second from the banquette of the front face on the left of the passage. The reinforcement of sappers was now withdrawn, and those in the fort only continued the work half-heartedly.

On the 20th the Japanese blew down the counterscarp of the front face in three places, and threw a quantity of faggots into the ditch. Three companies tried an assault which failed. From the 22nd to the 25th several further attempts to cross the ditch were foiled, and the brushwood was occasionally set on fire by grenades, torpedoes, rags soaked in oil and tar, tar barrels, and other combustibles, but the fires were soon extinguished. The Japanese fired a small charge in the exterior slope of the parapet itself to facilitate escalading, and masked their approach from the right salient by a strong sandbag traverse. On the 26th another assault was checked by fire from the retrenchment, and a counter-attack with the bayonet drove the assailants back into the ditch.

On the 1st of December the Russians heard from the passage the sound of Japanese pickaxes, and there was no longer any doubt that the latter were mining under the parapet. Information was also received from Fort Song-shu-shan that the mouth of the gallery was visible, and might even be destroyed by a lucky shot. On the 8th of December owing to the rocky nature of the soil the Japanese had to blast in their gallery under the left salient, the explosions were distinctly audible, and the blows of picks were also heard under the centre of the front face. On the 18th of December a reinforcement of 12 sappers was sent from North Ki-kwan after it had been captured by the Japanese. The Russian countermine galleries were now only 13 and 10 ft. long respectively.

On the 21st of December General Gorbatovski issued an order, based on the lessons of North Ki-kwan, in regard to the dispositions to be made when the front face was blown up. The craters were to be occupied a

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once, the troops taking filled sandbags with them. The cover would be better there than further in rear. The men were to be warned that there was nothing to fear from the explosions, and that the escalading would be carried out with some reluctance.

On the 27th the Japanese charged their mines, and, by keeping men at work with picks, completely deceived the Russians as to what was going on. The explosion was therefore quite unexpected. It occurred on the morning of the 28th, and was so violent that the walls of the barracks were shaken and the lights extinguished. Two large craters were formed, one on each side of the entrance to the passage under the ditch, and though formed in rock, the parapet was absolutely shorn off to the level of the terreplein. Large numbers of the assaulting troops were buried under the débris. The fort was shelled vigorously, even 11-in. guns being used. Ensign Poseda collected what troops he could find to defend the front face, but the Japanese held them at bay, and fifteen minutes after the explosions threw themselves on to the parapet. The Russian batteries and forts within range deluged the glacis and ditch with projectiles, but as they were themselves subjected to a heavy fire from the Japanese, their fire was not very effective. The Japanese succeeded in occupying and crowning the craters. Capt. Boulgakov, Commandant of the Fort, twice tried to lead parties from the barracks against the enemy, but the outlets were only wide enough for three men abreast, the Japanese machine guns mowed them down, and the counter-attacks failed. At 11 a.m. the fougasses prepared on the left flank were fired, and attempts were made to fire the charges placed under the foundations of the guard room, but they failed to explode. The central battery was by this time a ruin, but the Russians still held on to it. During the afternoon the Japanese crept slowly on, and at length captured the retrenchment. They now commanded the exits from the barracks, rapidly established flying saps, then a deeper trench in which they placed machine guns. Small parties tried to work round the flanks and turn the gorge, but still Capt. Boulgakov would not give in. At about 10 p.m. Lieut.-Colonel Gandourine, who was in command of that section of the defence, ordered the evacuation of the fort, and made arrangements for removing the wounded. The garrison retreated, taking with them their machine guns, ammunition, and provisions. The evacuation was completed by 2 a.m. on the 29th of December. The bedding in the barracks was saturated with kerosine, and set on fire, and the fuzes attached to some torpedoes stored near the gate were lighted. The bursting of these destroyed part of the passage, and the Japanese, for fear of further explosions, only entered the barracks next day. There remained in the fort three dismounted 6-in., seven 2-in. and a few other guns, which had all been rendered unserviceable before the evacuation.

Fort Song-shu-shan was of similar construction to the two forts above described, but was in trace triangular, with a blunted apex. The right flank was 82 yards long, the left 70 yards, and the gorge 83. The parapets had not been constructed, nor the ditch levelled. The flank ditches were enfiladed by casemates in the apex of the counterscarp, a caponier across the ditch joined these casemates to the fort, and provided flanking fire

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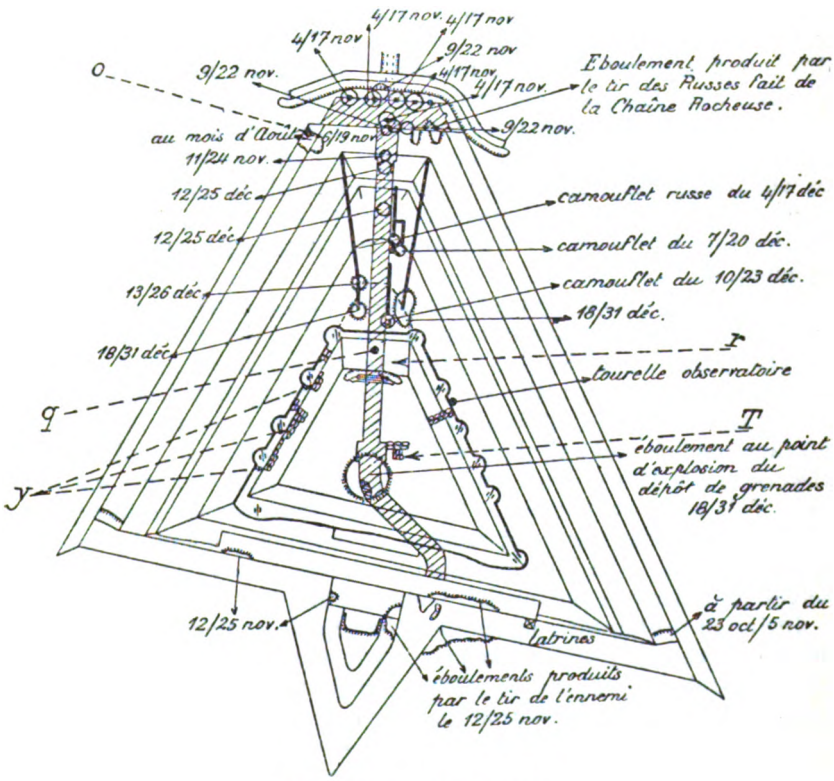
for the short front face. To prevent an enemy from using the roof of the caponier as a bridge, it had been intended to fix an iron palisade across it, but this had not been made when the siege commenced. The concrete barrack closing the gorge was a low narrow corridor with barred windows. Opposite the centre and joined to the barrack was a caponier to flank the gorge ditch and containing officers' quarters, etc.



Work No. 3.—Scale 1 : 2000.

To the right of the gorge caponier, on a level with the ditch, was a door leading into the barracks. Opposite this was a passage leading up to the terreplein in the centre of the fort, where were openings to each side, covered by traverses. Beyond these openings the passage descended again to the caponier and casemates in the apex of the fort. Across the terreplein the passage was unroofed. On the outbreak of the war the parapets, and revetment of the counterscarp was hurried on, and above the barracks, under the gorge parapet were placed blindages to serve as kitchens, stores, etc. The garrison was one company and a detachment of artillery. The glacis was surrounded by wire entanglement.

By the end of October, 1904, the fort had already successfully resisted several assaults, and the Japanese were established at the foot of the glacis. It had been proposed in September to countermine from the front casemates, but it was hardly expected that the Japanese could

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mine in the rocky soil, workmen and special tools were wanting, and countermining was postponed till the 27th of October, by which date it was evident that the safety of the casemates was imperilled. Two galleries were then commenced from the back of the casemates. On the 30th the Japanese made another assault, but their scaling ladders were too short to reach the bottom of the ditch (28 ft. deep). Their saps had, however, nearly reached the crest of the glacis over the casemates, and from thence they sallied out and threw bags full of rags into the ditch, and returning again, repeated the operation. They then jumped into the ditch and climbed the exterior slope. Received by the fire of the garrison from the parapets and casemate, and by reverse fire from the neighbouring works, they were forced to retreat with loss. During this assault a shell burst in the passage across the fort, killed two officers, one of whom was Capt. Chemetillo, Commandant of the Fort, and exploded a magazine, which caused great damage to the exits from the passage on to the terreplein. Fortunately reinforcements arrived at that moment.

The Japanese now crowned the glacis with a sandbag parapet, and commenced sinking shafts to blow in the roof of the casemates. On the 31st the Japanese ladders left in the ditch were destroyed with torpedoes. On the 5th of November the Japanese were clearly heard working on the roof of the casemate. It was decided to close the openings into the countermines, which had only been driven for about 7 ft. each, and on the 7th the casemates were vacated, and the opening into the caponier was walled up. This work was completed by the 10th, and meanwhile the sinking of the Japanese shafts was interrupted as much as possible by grenades, torpedoes, etc. The Japanese fixed thick wire screens to protect themselves, and many of the missiles burst harmlessly.

Owing to the hardness of the rock the Japanese mines were only ready to fire on the 17th of November. There was one on the roof, and six in the back wall of the casemates. Two of the latter missed fire, but the back wall was pierced and the front wall shaken. On the 18th the Russians retired behind a breastwork which they had built in the passage where it opened into the caponier, and placed a pom-pom there. The Japanese made further attempts to wreck the casemates, and on the 22nd a charge was exploded against the caponier, but did little damage.

On the 26th another assault was repulsed, the Japanese began to mine under the parapet, and the Russians sank a shaft and placed 35 lbs. powder at the end of a short gallery driven through the right wall of the passage just behind their first breastwork. It was to be fired electrically when required, but the wires were broken, and the mine was never used. Meanwhile a duel took place between the Russian pom-pom and a machine gun fixed by the Japanese in the casemate at the outer end of the caponier. Grenades were also used, and the air in the passage could hardly be kept fresh by a diver's pump placed at the outlet into the fort. It was now found that the Japanese were mining outside the right wall of the passage, and on the 5th of December the first breastwork was forsaken for a second about 25 yards further back. Some days later the first breastwork was partly wrecked by the Japanese. Another mine gallery was driven out to the right from behind No. 2 breastwork, and it

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and the passage were lighted by electric lamps. On the 6th the Japanese were heard at work in the caponier, and in the parapet of the front face, and it was proposed to make a sortie to ascertain what they were doing, but the idea was abandoned. On the 11th various noises betrayed to listeners in the passage the gradual advance of the Japanese. The Russian gallery behind the second breastwork had been driven about 6 ft., and then turned to the front at right angles, parallel to the passage. On the 15th it was calculated that the head was about 5 ft. from the Japanese gallery. A mine chamber was excavated and loaded with 100 lbs. of powder, tamped with sandbags and wooden frames. To prevent damage to the wall of the passage sandbags were piled on the inside and strutted back from the opposite wall. Blows on the wall of the passage deceived the Japanese, who had no idea that a mine was being charged. At 2 a.m. on the 17th the countermine was fired and must have been effectual. Heartrending cries were heard, and numbers of Japanese rushed out of their gallery into the ditch.

From Japanese sources it has been ascertained since the war that the Japanese were working on the following plan. First, by Boules' shafts to demolish the caponier, and second, to make two covered ways in the parapet to enable them to reach the interior of the fort without being hammered by the neighbouring works. To this end they had driven two galleries, one on each side of the passage, from the extremities of the front face. Then perceiving that the fort possessed this passage they drove a third gallery outside its right wall. It was this gallery that was damaged by the Russians.

In spite of careful tamping the passage had been filled with fumes, and could not be entered for half an hour. Nine hours later sounds of mining were heard further to the rear, the countermine gallery was untamped, and a branch commenced at an angle of 135 degrees. Three days later it was about 11½ ft. long, and the Japanese were close enough to be reached by a second camouflet. 70 lbs. of powder was placed in position and fired. The effect on the enemy was insignificant, and owing to poor tamping the passage was filled with smoke. The Japanese were soon at work again, and it was decided to remove the tamping and prolong the gallery, and also to begin another gallery near a third breastwork which had been built across the passage just in front of a vertical through the superior crest of the front parapet. However the Japanese were heard at work outside between the second and third breastworks, and work was concentrated on the new gallery only. This was sufficiently far advanced by 23rd for 40 lbs. of powder to be placed in it and fired. The enemy's gallery was destroyed, and the tamping was so carefully carried out that no fumes entered the passage. On removing the tamping the end of the Japanese gallery was found to be exposed, and a hail of rifle bullets greeted the miners. 20 lbs. of powder was laid in the open and fired, driving back the Japanese. It was decided to bring up a small q.f. gun, and then enter the enemy's mine, but while arrangements were being made the Japanese fired a mine laid on the ground, killing and wounding eight Russians. Work was now suspended on both sides.

The detachment of sappers in the fort had been reinforced on the 20th of December, and fresh galleries were driven right and left from the passage

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just behind the third breastwork. The Japanese were heard on the 23rd working on the roof between the first and second breastworks, the latter was therefore demolished in case it might be of use to them. The roof was blown in on the 25th, and grenades thrown into the passage, which produced such a suffocating smoke that the Russians had to retire behind their third breastwork, where a 1½-in. gun had been placed. On the 26th the Japanese fired a mine in the front parapet. Their tamping seems to have been insufficient, and little damage was done, the loopholes were unharmed, and the sentries remained at their posts. Grenades were thrown into the crater, but no assault was made by the Japanese, although they opened a heavy fire on the fort. On the 27th the Japanese tried to enter the passage, and threw in asphyxiating grenades, but the Russians kept them at bay.

By the 28th all the parapets were broken down, and through the earth banks covering the barracks the concrete walls showed in places. The outlet from the passage which was damaged on the 30th of October had been repaired, a sandbag parapet protected it on the right, and after the capture of East Erh-lung it was found necessary to protect the left flank by a parados. Preparations had also been made to blow up the barracks in case of necessity, 10 shafts had been sunk with chambers for 60 lbs. of guncotton each, and were ready by the 30th. On that date the work was violently bombarded. Charges had not been placed in the shafts in the barracks, but were stored under the beds, with detonators and Bickford's fuze ready fixed.

At 9 a.m. on the 31st two explosions sounded from the parapet caused by Japanese mines on either side of the passage. That on the left had little effect, on the right an oblong crater appeared, but still the crest was untouched. However the consequences were most disastrous, the garrison issued in a mass from the barracks, when a soldier struck with his foot a grenade placed in a magazine in the passage. The magazine blew up instantly, killing a large number of the defenders. Besides this, for some reason as yet unexplained, the charges of guncotton placed under the beds in the barracks were detonated and wrecked the whole building, 122 men out of the 250 then in the fort being killed. The Japanese rushed in over the ruins of the barracks and occupied the gorge, and the reinforcements hurried up by the Russians were forced to retire. General Gorbatovski telephoned an order for the garrison to surrender, seeing that it was impossible for more than a very few to save themselves by flight. 128 were made prisoners, of whom 65 were wounded. The subterranean war had lasted two months.

It may be deduced from the foregoing that as a general rule one mine gallery is insufficient. The opponent then has full liberty of action, and can avoid the danger. A system of galleries is required, especially in the case of defence by countermines.

One salient fact in all these operations was the capture, after a comparatively short period, of the casemates flanking the ditches of the three works. Shortly stated the events were as follows:—After the failure of their general assaults in August, the Japanese proceeded to construct regular siege works, in September and in October they again tried to carry the works by assault from a shorter distance but again

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failed. At the end of October at Fort North Ki-kwan, after ten days of close approaches they were in touch with the left end of the casemates, and on 30th they obtained possession of that end, but, hindered by the second Russian countermine, one branch of which protected the right half, it took them three weeks to completely capture the whole block. At Erh-lung East, where countermining was not commenced in time, the flanking work was taken on the 30th of October after a week only of close approaches. At Song-shu-shan, on the 5th of November, the Japanese threatened the walls of the casemates, there were no countermines, and the Russians being unable to make any defence had to abandon the flanking work. Comment is superfluous, the courage and stedfastness of the troops is unquestionable, it was only want of weapons, *i.e.*, of countermines, that led to the loss of the forts. A more stubborn defence of the glacis above ground could not have put a stop to the Japanese approaches. On an average, 2,000 grenades a day were used by the Russians besides other projectiles. Numerous sorties were made, which except for small local successes had no real effect on preventing the Japanese progress whether by sap or mine. The result would indisputably have been very different had a sound system of countermine galleries, prepared in peace time, been available from which to initiate a systematic underground defence.

A second fact which stands out clearly is the blowing up of the parapet as a prelude to the final assault. In all the three cases above described the processes were similar. After the capture of the works flanking the ditches successive assaults were attempted, preparations for which were made by constructing passages across the ditch, or by collecting scaling ladders and footbridges. Thanks to the mutual support afforded to each other by the forts, the more fragile implements were rapidly destroyed. The old methods were then resorted to, the counterscarp was demolished forming several roads for columns into the ditch, and heavy masses were poured over the parapet. As a preliminary to the last, the parapet was razed to the ground and thrown into the ditch, and to effect this the Japanese attacked with the spade the dead angles in the ditch, and buried themselves in the parapet out of reach of grenades and other projectiles, their progress only being interrupted by a few hastily constructed countermines. The parapets which had valiantly withstood the heavy artillery were not proof against these methods. The explosions disheartened the garrison while the ardour of the attackers was enhanced, and rushing over the smoking ruins the latter were soon in possession of the conquered fort.

We may here be allowed to diverge slightly from subterranean warfare to emphasize the close connection which ought to exist, during the attack on a fortified position, between the sappers and the infantry. After a lapse of two centuries it is no longer the artillery that must be enabled to close round the work, but the infantry. There are obstacles to destroy, gaps to be made in wire entanglements or other accessory defences, ditches to be filled up, parapets to be blown down, and conquered localities to be made good. All this is the work of the sapper, who precedes the infantry and smooths his path. A thankless task very often, the general public has a tendency to ignore the fourth arm.

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At Port Arthur, for the final assault on the works, a battalion of sappers always preceded the infantry, and there is no doubt that success was in a great measure due to the intimate association of the two arms. It is well to lay stress on this fact, viz., that strong bodies of sappers, carefully trained and disciplined to meet the difficulties and complexities of their comprehensive duties, are absolutely indispensable in the attack of fortified positions.

Among various surprises afforded by the Russo-Japanese War must be mentioned the use of mining in field warfare. During the winter of 1904-05 the belligerents were stationary for some months on the banks of the Sha-ho. The distance between the outposts was barely 100 yards. The *Revue du Génie*, 1907, Vol. XXXIV., p. 5, published details of this episode of the war. The Russians held the right bank, the Japanese the left, the latter also held the bridge of the Trans-Siberian Railway, and had organized a bridgehead on the right bank of the river. To capture it the Russians constructed several retrenchments, and then advanced by sap and mine. To meet this move the Japanese drove two galleries, one along the railway embankment against one of the retrenchments, the other against the Russian mine. On the night of 27th February the Russians attacked the bridgehead, and a reconnoitring party of sappers entered the Japanese galleries, securing as trophies several objects left behind by the Japanese in their precipitate flight. The bridgehead was abandoned.

There was another war of mines at the village of Li-chia-pu, where the Russians occupied a fortified retrenchment about 300 yards from the village temple, which was held by the Japanese. In November, 1904, a Captain of Engineers proposed driving a gallery to blow up the temple, but his suggestion was not adopted till the middle of the following January. It then became clear that the Japanese had carried a quantity of earth out of their temple, and subterranean noises were heard. The General accordingly ordered a system of countermines to be prepared in front of the retrenchment, work was put in hand and proceeded at the rate of about 25 ft. a day. By the 24th of February the head of the gallery was rather more than half-way to the temple. Noises were still heard, and the Russians, becoming apprehensive, opened a branch gallery, and on the 27th a Japanese miner's pick pierced the floor of this gallery. Several mine chambers were then made and loaded ; in all 2,000 lbs. of powder were used, and on the 28th the Japanese gallery was destroyed. There had been no means of ventilating the long gallery ; the miners frequently collapsed, and had to be relieved.

The war in Manchuria inaugurated the era of long battles, and without drawing general conclusions from these episodes of the war, it may not be rash to predict that in certain circumstances mines may be used in the attack and defence of fieldworks. Certainly defended positions which form pivots of manœuvre might well be protected by fougasses with electric connections carried underground, the vulnerability of conductors laid on the surface is too well known. Fired at the right time these fougasses might check the impetus of an assault more surely than any other means.

The writer concludes his interesting work by a short discussion of

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the probability of a European conflict being of sufficient duration to call for the employment of mining. It may be assumed that, in order to bring the war to a conclusion with the least possible delay, every legitimate means will be employed to defeat the adversary, and of these means mining is certainly not the least. The timely establishment of countermines will provide for the early extension of an active method of defence. In view of this possibility, however important may be the theoretical and historical study of the effects of mines, such study is not to be compared with practical experience. Mine warfare is, without doubt, an excellent way of training officers and men, it develops initiative and a sense of personality. The problems to be resolved are various and call for instant decision, the caprices of powder and the trickiness of soils demand constant study, the anxiety to guard against surprise stimulates listeners and observers, the deductions to be made in regard to the distances of sounds strengthen the judgment, and the old stager will form a correct opinion from one single fact where a beginner would fall into error. Attack and defence by mining should undoubtedly be practised constantly during peace, the lessons to be drawn from it are invaluable.

A.R.R.

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REVIEWS.

FIELD ENTRENCHMENTS: SPADEWORK FOR RIFLEMEN.

Written by an Engineer Officer attached to the Imperial General Staff. Edited by E. JOHN SOLANO.—(London: John Murray, Albemarle Street, W. 1s. net).

THIS little work, which is based on official manuals, covers Hasty Fire Cover, Fire Trenches, Communication, Concealment, Obstruction Shelters, Defence of Villages, Woods and Buildings, etc. It is a convenient size, with a good Index. No better idea of its value can be given than the Introduction, which is written by Major-General G. K. Scott-Moncrieff, C.B., C.I.E., R.E., D.F.W., and is as follows:—

I have been asked to write a few words of introduction to this book on Field Entrenchments. The writer, who prefers to remain anonymous, has concentrated on this subject something like twenty years of practical study, acquired partly during the whole of the South African War, in which he gained distinction, partly by close observation of the battlefields of Manchuria, partly by years spent in training cadets, and as an officer in command of a field company of Royal Engineers. I have known him since he joined as a young officer at the School of Military Engineering, where I was then an Instructor, some twenty years ago, and I can confidently say that there is no one who knows the subject better, or more able than he is, to impart to others the knowledge he has acquired.

This work is based, therefore, not on the armchair theories of the student, but on the stern realities of war. Its value has been exemplified in a startling manner during the present colossal strife in North-East France.

The book discusses the field work of the spade in its true relation to tactics. I do not know of any important points that are omitted, though possibly the experience of the present campaign may add some new matter for consideration and cause us to modify others. In one particular—namely, in the use of sapping where two entrenched lines lie opposite each other, and manœuvring is impossible—the teaching in this book has anticipated the present operations.

There is nothing pedantic, nothing superior about the work. While the application of its teaching must be left to individual resource and energy, the knowledge contained in it should enable any officer to instruct his men, under varied conditions of warfare, in an art which has become more and more vital to the many, and no longer the science of the few.

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THE SOLDIERS' LANGUAGE MANUAL.

ENGLISH–FRENCH.

By AJAX.—(London : E. Marlborough & Co., 51, Old Bailey, E.C. 3d.).

A SOLDIER fighting in a foreign land has to meet a real and constant difficulty when unable to converse with the inhabitants. The drift of war takes him from where his own tongue is understood and he comes into touch with all classes of people who know nothing of English. The acquaintance of even a few of the most ordinary words and phrases in every-day life, and especially in every-day military life, will not only be an immense help but will render him a far more efficient soldier. Indeed, if by duty or misfortune he gets isolated from his comrades, it may go far to enable him to bring his business through with success, or to secure him succour and relief.

With this in view *The Soldiers' Language Manual* has been prepared ; much thought and care have been exercised in compiling the Vocabularies and Phrases ; and just enough notes on the grammar have been given to help in the formation of simple sentences for ordinary requirements.

For the Phonetic Pronunciation Marlborough's " Self-Taught " System has been used. It is simple and with practice will speedily remove any diffidence in making first attempts to speak French, while with a little attention the sounds of the same language spoken by others will soon be understood. The book will be found very useful to anyone not acquainted with the French language, and its price places it within the reach of everyone.

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NOTICE OF MAGAZINE.

RIVISTA DI ARTIGLIERIA E GENIO.

June, 1914.

SEARCHLIGHTS IN FIELD WARFARE.

The following notices, relating to the employment of searchlights in the great units of the Russian Army, for the purpose of diminishing the difficulties of nocturnal operations, are extracted from No. 56 of the *Militär-Wochenblatt*.

Each army corps has a photo-electric detachment which is attached to the sapper battalion of the engineers. The detachment is subdivided into sections as follows :—(*a*). One section for a searchlight of 90 c.m. for the commander of an army corps (1 officer, 6 men, 1 automobile, 1 transport wagon); (*b*), one section for a searchlight of 75 c.m. for the commander of an army corps (1 officer, 31 men, 24 horses, 2 wagons, 6 two-wheeled carriages, 3 cars for provisions and baggage); (*c*), two sections for searchlights of 60 c.m., one for each divisional commander (organized as above for the 75-c.m. section); (*d*), eight sections for searchlights of 40 c.m., one for each infantry regiment (14 men, 2 wagons, 1 one-horse car, and 1 baggage wagon).

In particular cases sections for searchlights of 40 c.m. are provided for mountain troops and for cavalry. With each searchlight there are 3 or 4 microtelephonic sections.

Technical Characteristics.—Luminous intensity

8,630,000 candles for searchlight of 40 c.m.
27,200,000 ,, ,, ,, ,, 60 ,,
42,300,000 ,, ,, ,, ,, 75 ,,

Anyone coming under the luminous cone of the searchlights remains quite dazzled. This happens especially when the light alternates frequently from light to darkness. The light issuing from a searchlight renders inefficacious that of a less powerful searchlight. Clear light, humidity, and rain weakens the illuminating power, and renders observation more difficult. Mist and smoke are not penetrable by the light of the searchlight. Behind a mask of smoke movements and works can be carried on without fear of discovery by the enemy's searchlights. For a station placed at 8 m. from the ground observation is possible at the following distances :—

For searchlights of 40 c.m. against buildings 8 k.m., against men 1·75 k.m.
,, ,, ,, 60 ,, ,, ,, 10 ,, ,, ,, 2 ,,
,, ,, ,, 75 ,, ,, ,, 11 ,, ,, ,, 2·3 ,,
,, ,, ,, 90 ,, ,, ,, 11·5 ,, ,, ,, 3 ,,

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The greatest distance is about 14 k.m. for the more powerful searchlights. Light objects, especially on a dark background, appear nearer than otherwise; dark objects (trees, bushes, etc.) appear more distant. Yellow objects appear white; light green objects appear yellowish. Dry roads, mounds, walls, trees devoid of foliage, hedges, telegraph poles become slowly conspicuous. Wet roads and moist ground look misty. Heights and steep precipices become slowly visible and seem higher, while slight undulations are concealed or confused in appearance. Troops in black or white uniforms are easily discernible, those in brown are more difficult, grey uniforms appear only when projected on a grey background. Steel or objects of metal and metal helmets at once catch the eye. Troops on the march are more easily discernible than those halting, troops lying down are scarcely visible. Close formations should not be formed when under the action of searchlights. The eyes of horses shine with a greenish colour even at a considerable distance. Woods and bushes sometimes render observation absolutely impossible.

Tactical Characteristics.—Searchlights of 60 and 75 c.m. are heavy and difficult of transport so that they cannot be rapidly fixed in position. Those of 40 c.m. on two-wheeled carriages with two horses are better in this respect.

Flat and bare country allows of the full utilization of searchlights but causes observation to be more difficult since every part has to be searched. In a covered country the observation is also more difficult, but it is limited to certain determined spots from which the advance of the enemy is probable. In hilly land the numerous spaces in shade favour the enemy's approach. In woody country it is preferable to use light and easily movable searchlights of 40 c.m. in the glades. The best position for the observatory is in front and to the side of the searchlight and about 25 m. from it. The employment of two observatories is recommended; one on each side and connected by telephone with the searchlight. The observation posts should be masked from the enemy and can also be used for change of cover for those with the searchlights. The observer should reconnoitre the ground assigned for observation before nightfall.

Duties assigned to Searchlights.—To search the ground towards the enemy, to illuminate permanently the points which have to be traversed by the enemy; to illumine spots in the enemy's front that have to be swept by fire; to dazzle the enemy; to unite surprise light with fire in order to create panic among the enemy; to deceive the enemy as to the position of the troops by placing searchlights laterally; to assist the working parties and the movements of friendly troops; to transmit messages (visible up to 70 k.m.).

Duties for Offence.—To illumine the direction of the march; to disturb the enemy's works by illumination; to light up the points of attack in preparing for the assault; to light up the points of direction for gaining the positions for assault; to neutralize the action of the enemy's searchlights; to assist in the destruction of obstacles; immediately before the assault to direct the luminous rays behind the enemy's advanced lines in order to discover the reserves; to cover the retreat in event of failure of friendly troops, dazzling the enemy, and establishing a shield of light.

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Duties for the Defence.—To light up the more important approaches to the position especially on the flanks; to illuminate certain spots of the ground in front, and to keep the enemy within the luminous cone; to neutralize the action of the enemy's searchlights; to cover the movements of the troops, creating a luminous shield in front of them; to light up the enemy's position so as to facilitate the fire of the guns; to dazzle the enemy during an assault and to interpose before him a luminous zone 150 m. wide; to disturb and confuse the enemy after an unsuccessful assault; to assist the counter-attacks by dazzling the enemy and throwing him into disorder.

Duties for Advanced Posts.—To illuminate the more important approaches; to assist the action of the patrols and advanced posts in reconnoitring and observation services; to aid the combats of advanced posts by dazzling the enemy; to cover the retreat of advanced posts, dazzling the enemy and interposing a shield of light. Troops in movement if halted remain immovable; on the approach of the luminous rays they may throw themselves to the ground. On ground that does not offer any cover it may be advisable to carry leafy branches of trees under whose shadow the men seek cover.

Arrangement and Disposition.—The conditions that satisfy the best position for searchlights are a free field for illumination; favourable points for observation; non-interference with friendly troops; possibility of communicating with the observers working with other searchlights. Heavy searchlights should generally be placed in rear of the friendly troops and perhaps somewhat above them. If this cannot be done, it is advisable to place them on the flanks, or in the intervals. Light searchlights can be placed somewhat in front but in such case should be assured against surprise. Since the sector of illumination does not surpass 60 degrees to obtain good results it is advisable to have one searchlight of 60 or 75 c.m. for each kilometre of front, or two searchlights of 40 c.m. For a regiment in position there should be two heavy searchlights and two smaller ones. According to the number of searchlights available they should be allotted to regiments or detachments. The searchlights are divided into groups, and work in common accord, under the direction of an officer attached to each group, and they should be in telephonic communication with the commander of the sector and with the observer of each searchlight. The commander of a sector should be in touch with each station commander and should keep him informed on the situation, on the scope of the combat, and on his own intentions and should prescribe the exact duties for the searchlights. The chief officer of the group should also know the situation of the contiguous sectors. Everything required to be made known should be transmitted in good time so that there may be sufficient time to prepare the technical arrangements. The same applies to information to be given to the observers. It is necessary to avoid the searchlights interfering with the lights of others in the vicinity. The use of too many searchlights would be likely to diminish their value.

E. T. THACKERAY.

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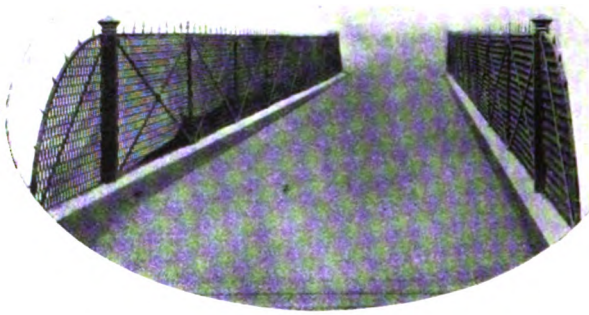

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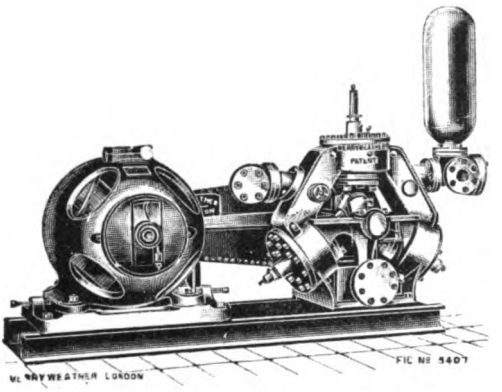

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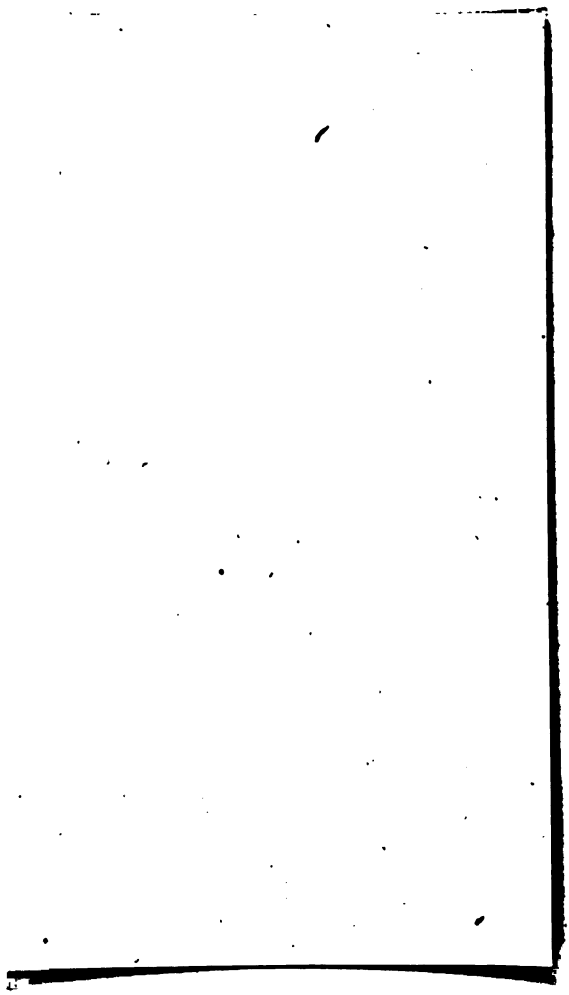

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